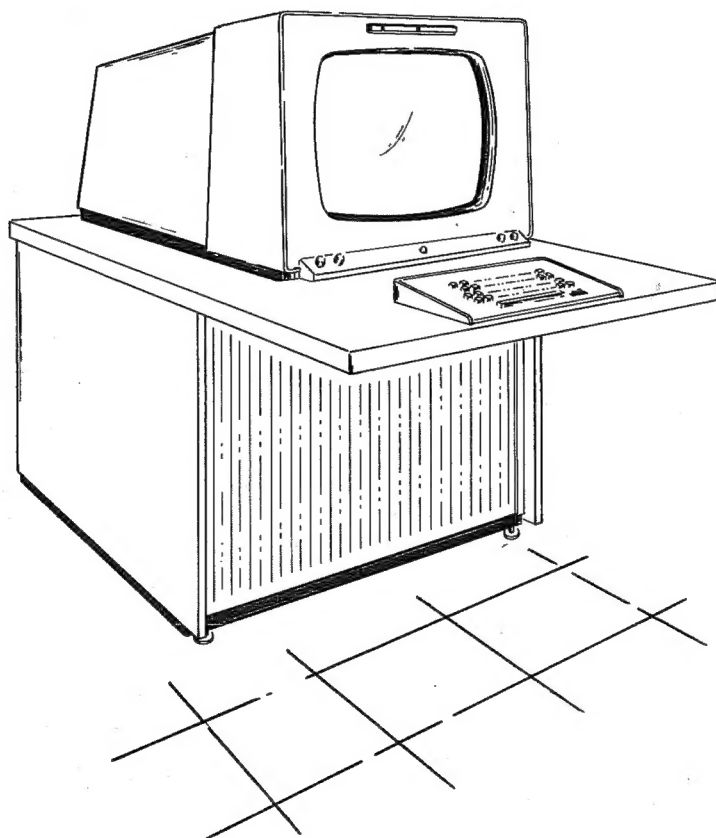


CONTROL DATA[®]

CYBER 170 DISPLAY STATION

CC545-C/D/E /F



CONTROL DATA
CORPORATION

**HARDWARE REFERENCE/
CUSTOMER ENGINEERING MANUAL**

REVISION RECORD	
REVISION	DESCRIPTION
A	Final release. This printing obsoletes all previous editions.
(04-15-75)	
B	Revised to add assembly drawing 61384200 (Cable Assembly Keyboard
(06-06-75)	Switch).
C	Incorporates ECOs 10621, 10708 and 10692.
(08-15-75)	The top assembly parts lists were restructured resulting in a reduction of
	the number of parts lists pages.
D	Revised to include ECOs 10771 and 11024.
(12-31-75)	
E	Revised to include ECOs 11208, 11239, 11259 and 11291.
(03-09-76)	
F	Revised and reprinted. Includes ECOs 11333 and 11391 and all previous
(05-17-76)	changes. This edition obsoletes all previous editions.
G	Incorporates ECOs 10518, 10711, 11376, 11489, 11536, 11548, and 11590.
(08-06-76)	This revision also incorporates a new power control panel assy
	(P/N 61407475/76) and adds keyboard assy (P/N 51730800).
H	Incorporates ECO/FCO 11643 - to prevent looseness and eventual
(02-21-77)	removal of side panels through vibration.
J	Incorporates ECOs 11948 and 12093 - Eliminates interference with
(05-18-77)	wheels of casters caused by extension fit of nuts and lockwashers;
	beam settle time for the CC545 has deteriorated due to an uncontrolled
	parameter of the 27-v zener diodes used in the deflection amplifier.
K	Incorporates ECO 12222 and SB 3372. Makes corrections, changes, and
(10-08-77)	additions to update manual.
Publication No. 62952600	

01989-1

REVISION LETTERS I, O, Q AND X ARE NOT USED

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 Printed in the United States of America

Address comments concerning this
 manual to:

Control Data Corporation
 Technical Publications Department
 2401 North Fairview Avenue
 St. Paul, Minnesota 55113

or use Comment Sheet in the back
 of this manual.

REVISION RECORD (CONTD)

[illegible]

Publication No.
62952600

01990-1

MANUAL TO EQUIPMENT LEVEL CORRELATION

This manual reflects the equipment configurations listed below.

EXPLANATION: Locate the equipment type and series number, as shown on the equipment FCO log, in the list below. Immediately to the right of the series number is an FCO number. If that number and all of the numbers underneath it match all of the numbers on the equipment FCO log, then this manual accurately reflects the equipment.

EQUIPMENT TYPE	SERIES	WITH FCO'S	COMMENTS
CC545-C	01	9469, 9543	ECO 9807
	02		ECO 9832
	03	9821, 9829	
	04	10277, 9561	
	05	10214	
	06	11376	
	07	11643	
	08		
CC545-D	01	9469, 9543	ECO 9807
	02		ECO 9832
	03	9822, 9829	
	04	10277, 9561	
	05	10214	
	06	11376	
	07	11643	
	08		

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MANUAL TO EQUIPMENT LEVEL CORRELATION (CONTD)

EQUIPMENT TYPE	SERIES	WITH FCO'S	COMMENTS
CC545-E	01		
CC545-F	01		

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LIST OF EFFECTIVE PAGES

New features, as well as changes, deletions, and additions to information in this manual are indicated by bars in the margins or by a dot near the page number if the entire page is affected. A bar by the page number indicates pagination rather than content has changed.

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Title Page	-	5-15	K	7-2 thru 7-4	A
iii thru xix	L	5-16	E	7-5	L
1-1/1-2	A	5-17/5-18	F	7-6	A
1-3	L	5-19	K	7-7	L
1-4 thru 1-8	A	5-20	F	7-8	A
1-9	E	5-21	K	7-9	L
1-10	A	5-22	F	7-10	A
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3-3	A	5-27/5-28	L	7-24.1/7-24.2	L
3-4 thru 3-6	L	6-1	A	7-25 thru 7-28	L
3-7 thru 3-9	A	6-2	L	7-28.1/7-28.2	L
4-1	A	6-3 thru 6-9	A	7-29 thru 7-54	A
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5-14	K	6-25 thru 6-30	A	8-16	A

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FOREWORD

This manual documents the CONTROL DATA® CYBER 170 Display Station, equipments CC545-C/D and the U.L. listed equipments CC545-E/F. The display station contains a 21-inch crt to display information received from a computer via a CYBER 170 Display Controller and an alphanumeric keyboard to enable an operator to input information to the computer.

The following information is included here to inform the reader about certain changes and additions that have occurred to the display station and how these conditions affect this manual.

- The running time meter (M1) has been removed from the power control panel. It has been permanently discontinued commencing with current display station production.

Manual affected — Descriptions of the running time meter throughout the text are left intact to provide continuing support for those display stations containing them. Therefore, users of display stations without a running time meter should overlook any reference to a meter in the manual text because that material would not be applicable in their case.

- A different high-voltage power supply, part number 51918275, has been incorporated commencing with current display station production. This supply replaces the existing power supply, part number 61369600. Because both power supplies are identical in hookup procedures and output voltage, they are considered interchangeable. This means one type of power supply can replace the other, and vice versa, in event of failure.

Manual affected — Both power supplies are described in the manual text. Separate material is provided where necessary and is identified by the part number of the power supply. There are no schematic diagrams or parts data information for the later version power supply, 51918275. Upon failure, do not attempt to service this unit; just replace it with a new power supply.

- Two card changes have occurred.

The 8BMD (part number 90445928) replaces the 619 (part number 82199922) card. These two cards can be used interchangeably.

The 1222RS (part number 82199951) is replaced by the 1222RS-1 (part number 90446012) card.

Manual affected — Schematic diagrams and parts data material for both of the new cards has been incorporated.

There are nine sections in this manual. These sections are as follows: Section 1, General Description, which provides a general description of the operational, functional, and physical characteristics of the station; Section 2, Operation and Programming, discusses operator controls/indicators and includes pertinent programming information; Section 3, Installation and Checkout, explains how to make the station operational; Section 4, Theory of Operation, explains how the various circuits function together to perform station operations; Section 5, Diagrams, contains the power, cabling, logic, schematic diagrams for the station; Section 6, Maintenance, describes preventive and corrective maintenance procedures; Section 7, Maintenance Aids, provides cabling, card placement, and individual card descriptions; Section 8, Parts Data, includes illustrations and itemized lists of field repairable and replaceable parts; Section 9, provides a suggested list of Spare Parts.

Additional copies of this manual may be ordered from:

Control Data Corporation
Literature and Distribution Services
304 North Dale Street
St. Paul, Minnesota 55103

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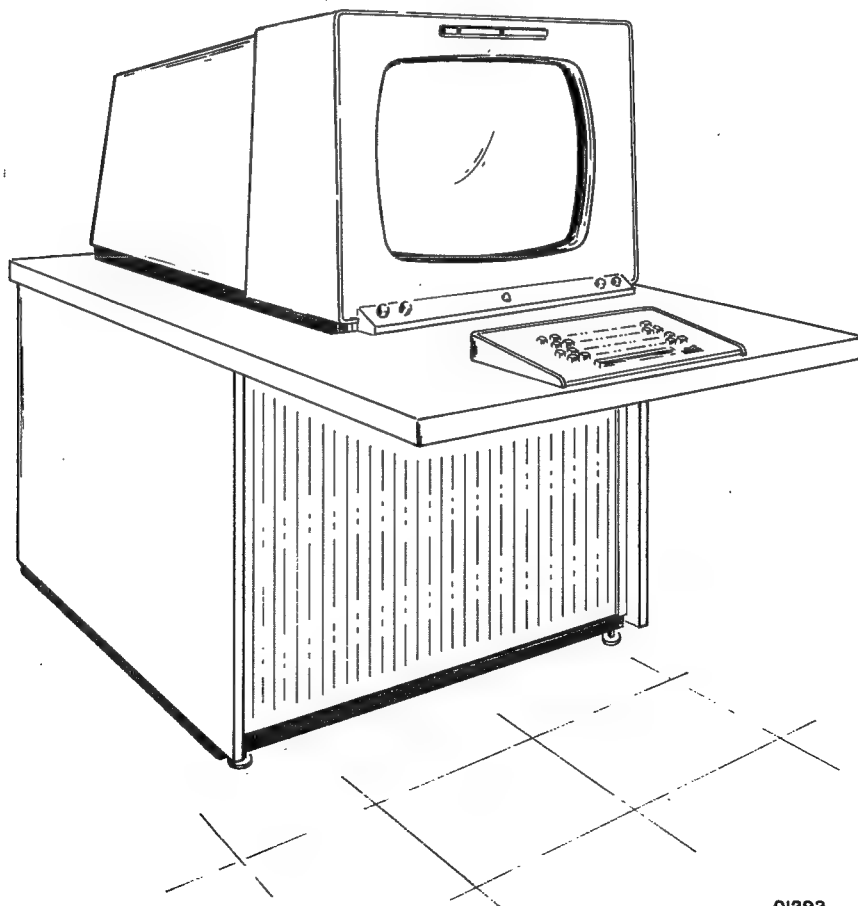
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SECTION 1

GENERAL DESCRIPTION

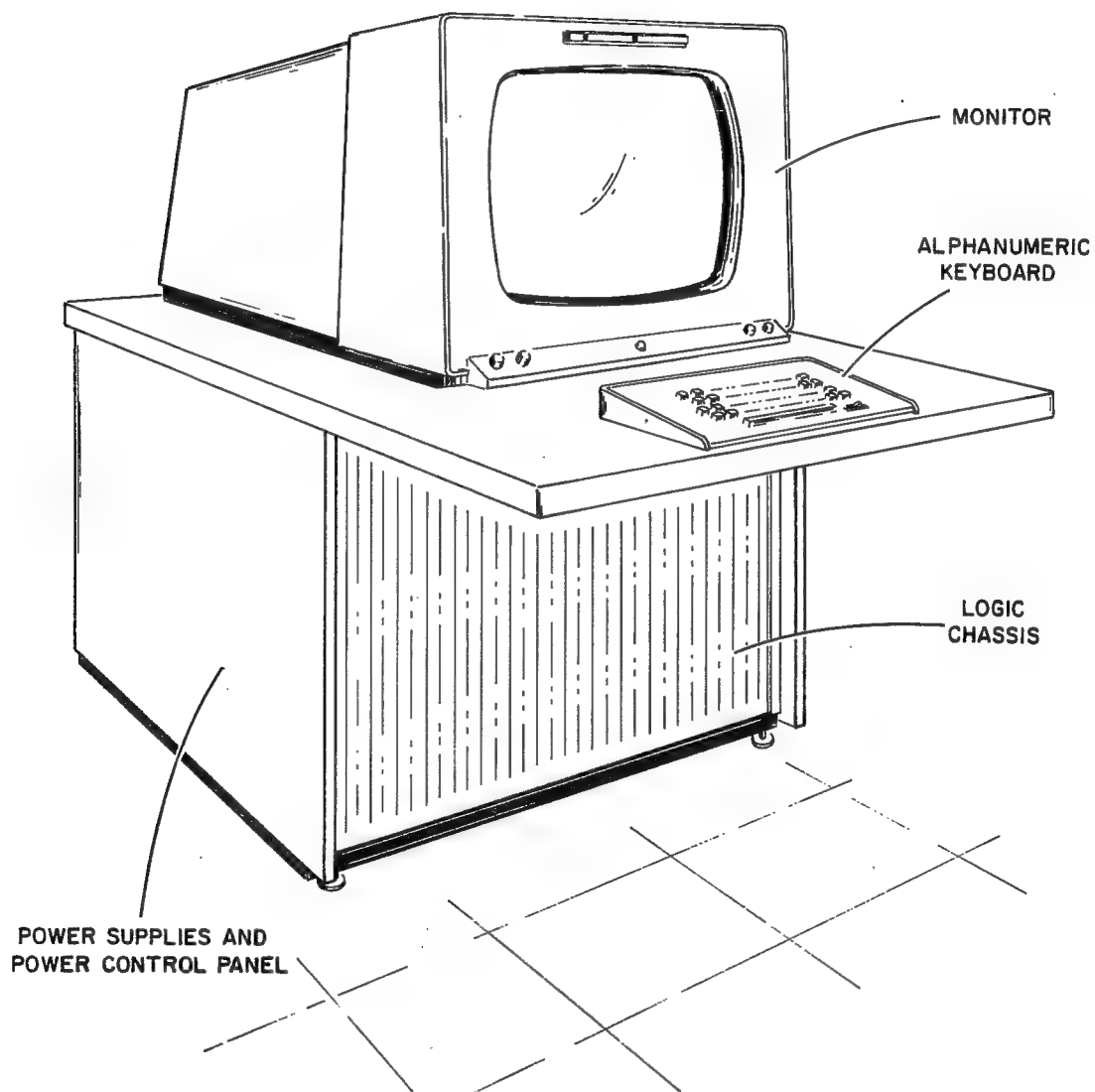
The CDC CYBER 170 Display Station, figure 1-1, provides a visual, alphanumeric readout for the associated computer. The receipt of symbol and position information from the computer enables displaying program information on the console cathode-ray tube (crt). The station also contains an alphanumeric keyboard which enables an operator to send data to the computer. The keyboard/crt combination permits the operator to modify computer programs and to see the result on the screen. The computer outputs two alternate, nonrelated data streams, and the keyboard has a three-position rocker switch which enables the selection of either LEFT, RIGHT or BOTH (maintenance mode) presentations for display.



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Figure 1-1. CYBER 170 Display Station

The display station can be divided into three major operational areas: power and control which contains the power supplies, power control panel, blowers and digital-to-analog (d/a) chassis; monitor which contains the crt, the deflection amplifier, the high-voltage power supply, and the feedback amplifier cards; work-shelf which contains the alphanumeric keyboard. Figure 1-2 shows the location of the major functional areas.

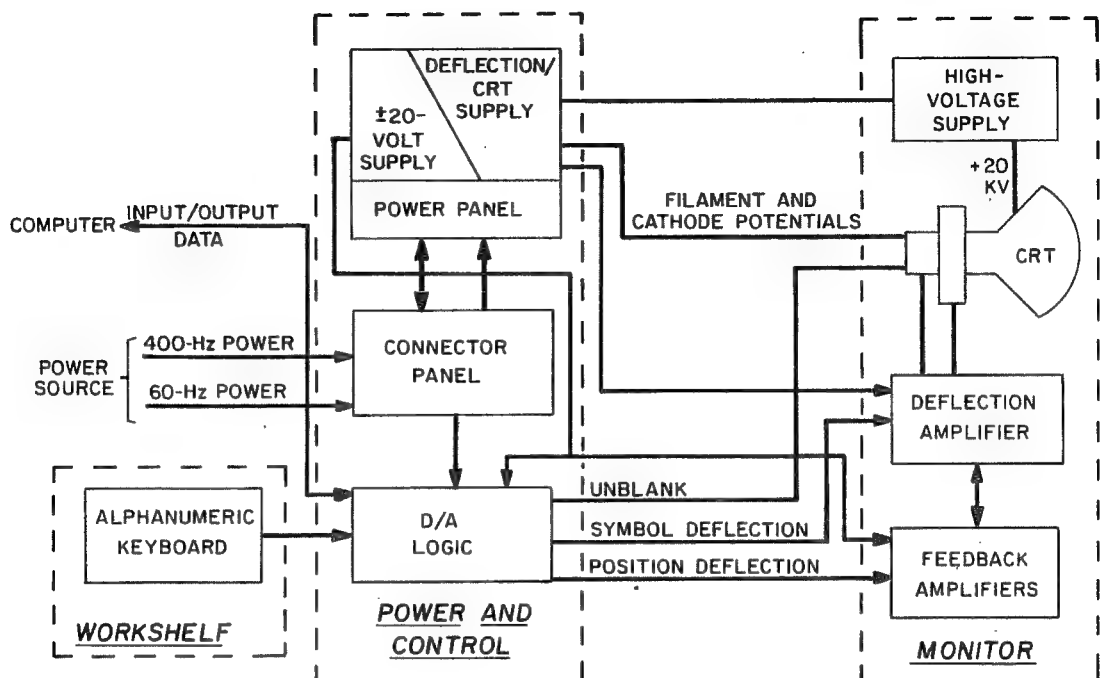


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Figure 1-2. Display Station Functional Areas

FUNCTIONAL DESCRIPTION

Figure 1-3 provides a graphic illustration of the three major functional areas of the display station. The following paragraphs explain the operation of these areas.



01293-1

Figure 1-3. Display Station Functional Block Diagram

POWER AND CONTROL

The power and control circuitry forms the nucleus of the display station. The connector panel distributes power from the power source to the power panel with its associated power supplies and to the d/a logic. The d/a logic accepts base position, analog, and digital data from the computer. The resulting output from the d/a logic enables the positioning of the crt electron beam and the painting of symbols. The d/a logic also accepts data encoded on the alphanumeric keyboard and transmits these codes to the computer.

Power Control Panel

The power control panel contains maintenance controls and indicators which enable on/off and thermal condition control and indication. In display stations where used, a running time meter shows the "on" time of the station. The power control panel receives power from the 50- or 60-Hz and 400-Hz sources and routes it to the ± 20 -volt supply, the deflection/crt supply, and the blowers. It also routes power from the ± 20 -volt power supply to the deflection/crt supply and to the deflection amplifier high-temperature thermostats and the d/a chassis. Power off and high-temperature thermal delays provide 15 seconds between the dropping of the high voltage to the crt and the turning off of all power or deflection/crt supply input power.

± 20-Volt Supply

Outputs from the ± 20-volt supply furnish power to the circuit cards in the d/a chassis, the feedback amplifiers, the deflection amplifier, the high-voltage power supply via the deflection/crt supply, and the symbol yoke on the crt.

Deflection/CRT Supply

In addition to providing two + 40-volt outputs for the X- and Y-position yoke windings, the deflection/crt supply provides operating potentials for the crt. Refer to figure 1-3. Also, the deflection/crt supply controls high-voltage power supply turn-on. Approximately 15 seconds after applying power to the rest of the station with the POWER ON switch, a thermal delay turns on the high-voltage supply and applies the focus potential to the crt. This delay allows the crt filaments to warm up before applying high voltage.

D/A Logic

The d/a logic accepts digital base position and analog symbol data from the computer and transmits alphanumeric codes to the computer. Digital base position information specifies unique crt electron beam positions within the 8 inches for normal mode and 12 by 8 inches ~~square~~ for maintenance mode square display raster area. The computer specifies a raster position with digital information consisting of 9 bits for the X-coordinate in normal mode, 10 bits for the X-coordinate for maintenance mode and 9 bits for the Y-coordinate. With these bits, the X- and Y-coordinates may vary from 000 to 777 octal for each presentation. The d/a conversion circuits transform each unique combination of digital bits to a special analog voltage. The analog voltage positions the crt beam by changing current flow through the crt base position yoke. This scheme results in a raster of 512 by 512 selectable positions for each presentation. After the base positioning operation, a symbol is painted by means of inputs on the symbol analog signal lines in conjunction with the unblank signals. In addition to symbol deflection, the controller specifies when to turn on (unblank) and turn off (blank) the crt electron beam. Selectively unblanking and blanking the electron beam permits displaying only those beam movements composing a symbol.

The X- and Y- analog symbol lines supply push-pull analog signals to the symbol deflection chain. These signals produce moves on the crt by changing the current applied to the symbol yoke. These vertical and horizontal analog symbol signals are amplitude-modulated by two digital size selection bits from the controller. The following comparisons between the symbol size and the possible selectable positions show the relative size relationships between the three possible symbol sizes and the total raster size: a large size symbol takes up the space addressed by 32 by 32 of the

possible selectable positions (512 by 512); a medium size symbol corresponds to 16 by 16 of the selectable positions; a small size symbol corresponds to 8 by 8 of the selectable positions. The gross position coordinates, however, determine only where the symbol is drawn on the crt; the symbol shape is determined only by the push-pull analog inputs and the digital unblank signal.

The 6-bit key codes from the alphanumeric keyboard reach the controller via the 4ABD-1 interface card in the d/a logic chassis.

MONITOR

The monitor provides visual display of alphanumeric data via a 21-inch, electromagnetic-deflection crt and its associated circuitry. The associated circuitry consists of the high-voltage supply, feedback amplifiers, deflection amplifier, symbol yoke, and position yoke.

The high-voltage supply provides a + 18-kilovolt accelerating potential for the crt electron beam.

Deflection amplifier outputs control base position and symbol deflection current through the position and symbol yokes, respectively. This varies the electromagnetic fields produced by the yokes, thus changing the position at which the electron beam strikes the crt phosphor. Feedback amplifiers, X and Y, provide additional amplification of X and Y summing amplifier outputs in the d/a logic before application to the deflection amplifier.

ALPHANUMERIC KEYBOARD

The alphanumeric keyboard provides coded binary signals to the computer interface. Depression of each key generates a unique 6-bit octal code. An interface card in the d/a logic rack sends key codes to the computer. With all keys released, the computer receives an octal code of 00 on the keyboard lines. The result of pressing more than one key simultaneously is a logical OR combination of the individual key codes. See Section 2 for clarification.

OPERATIONAL DESCRIPTION

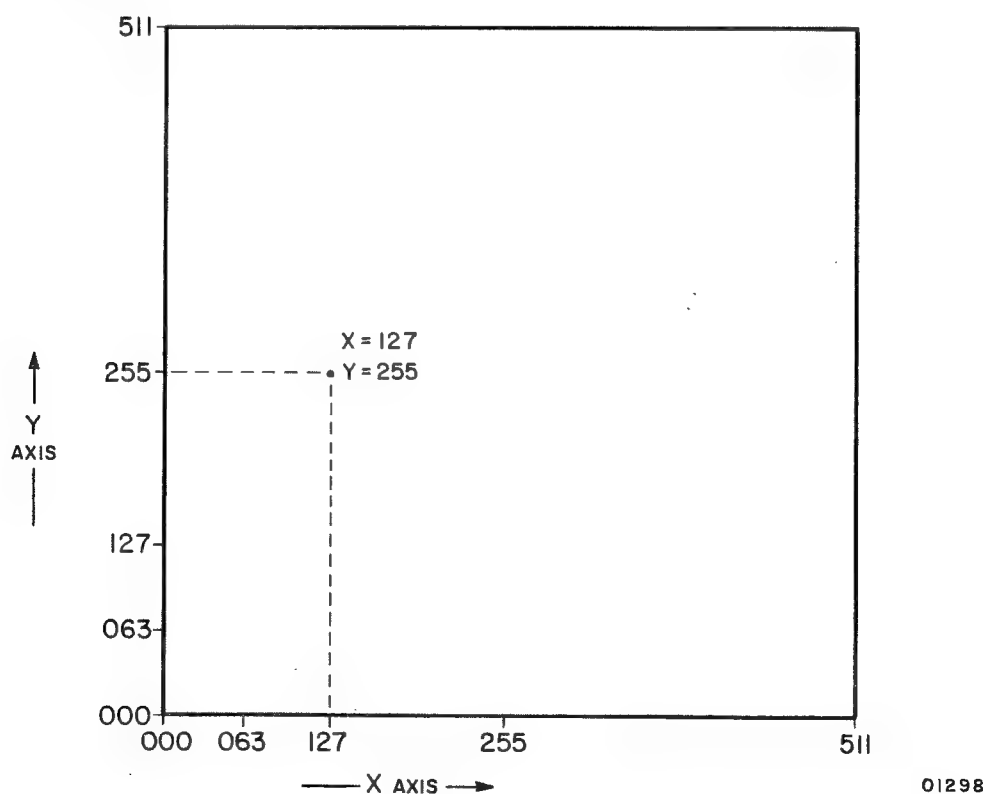
The operational description presented here provides a simplified explanation of display generation. Digital computer inputs generate alphanumeric display images within an 8-inch by 8-inch (for normal mode and 12-inch by 8-inch for maintenance mode) display area on the 21-inch crt. The crt is rectangular and employs electromagnetic deflection.

IMAGE GENERATION

An electron beam in the crt produces a visible display when it strikes the phosphor-coated crt screen, causing that portion of the phosphor to glow briefly. The phosphor color is green. Normally the glow fades within a fraction of a second, too soon for the human eye to perceive and identify the image. For this reason, the display image must be redrawn continuously (refreshed) at a rate which makes the display appear steady and of uniform intensity to the observer. Display refresh is under computer program control. This rate should be approximately 50 hertz to avoid flicker.

DEFLECTION

Position words, transmitted by the computer, control electron beam positioning (deflection) on the crt screen. These position words specify electron beam deflection to horizontal (X) and vertical (Y) coordinates on a square grid composed of possible electron beam positions. This grid (called a raster) covers the 8- by 8-inch = normal (12 by 8 = maintenance mode) display area on the crt screen. There are 512 (1000 octal) equally spaced X positions and 512 (1000 octal) equally spaced Y positions as shown in figure 1-4.



NOTE: ONE RASTER UNIT = 0.015625 INCH, 64 RASTER UNITS = 1 INCH, AND 512 RASTER UNITS = 8 INCHES IN NORMAL MODE.

Figure 1-4. Display Area Coordinate System

The distance between two sequentially addressable lines on the raster is called a "raster unit." A raster unit represents 1/512 of an image in either the X or Y direction in normal mode.

By transmitting X and Y push-pull symbol deflection signals and controlling crt beam unblank with a single bit, the computer directs crt beam painting of symbols within imaginary 8 by 8 (small), 16 by 16 (medium), or 32 by 32 (large) symbol matrixes. The gross position coordinate is the center of the symbol matrix; however the influence of push-pull symbol inputs will cause the actual symbol-paint starting point to be at the lower lefthand corner of the imaginary matrix (see figure 1-5). Maintenance adjustments permit adjustment of the three individual symbol sites. Symbol positioning within the display area is strictly under computer program control, while symbol shape is determined by the controller.

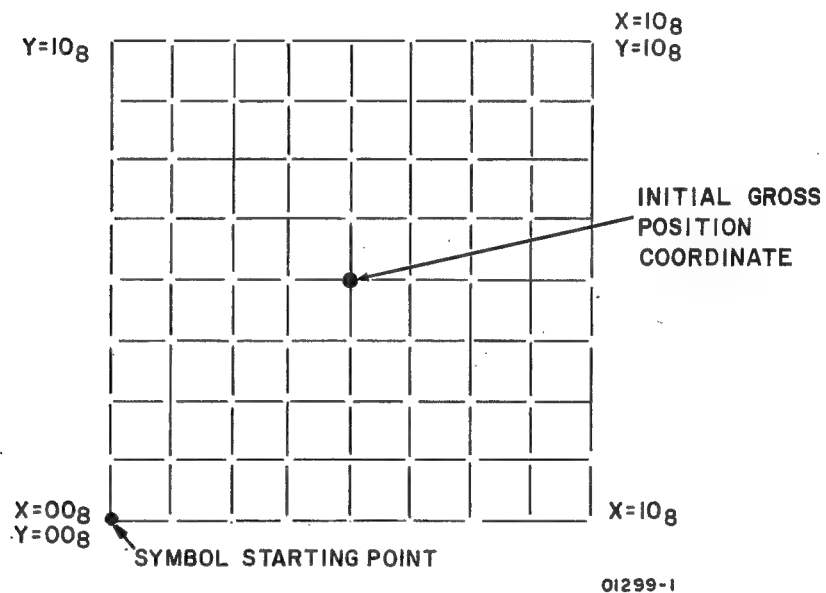
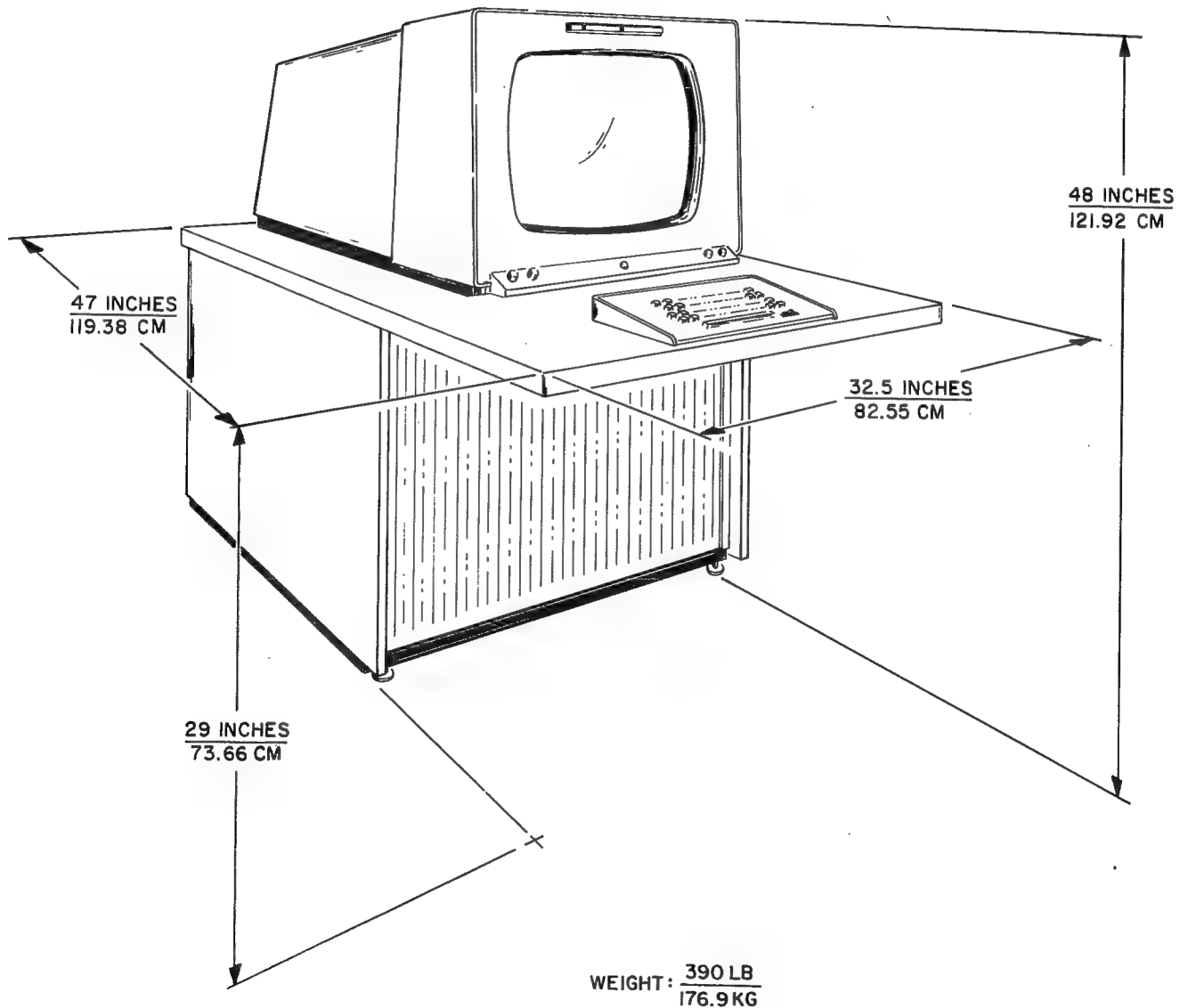


Figure 1-5. Imaginary Symbol Matrix, Small Size

PHYSICAL DESCRIPTION

Figure 1-6 shows the physical dimensions and weight of the station. Input cables enter the station through an opening in the bottom rear of the cabinet.



01292

Figure 1-6. Station Dimensions and Weight

ELECTRICAL DATA

The display stations are available for operation from either 60-Hz or 50-Hz single phase power. In addition, both options require 400-Hz three-phase power. Applicable data is:

CC545-C/E

104 - 127 vac, 59 - 60.6 Hz, 1 phase, 2.7 amp per phase
200 - 212 vac, 370 - 500 Hz, 3 phase, 3.0 amp per phase

CC545-D/F

198 - 246 vac*, 49.0 - 50.5 Hz, 1 phase, 1.6 amp per phase
200 - 212 vac, 370 - 500 Hz, 3 phase, 3.0 amp per phase

NOTE

Equipments CC545-E and CC545-F are U.L. Listed.

ENVIRONMENTAL DATA

Operational and nonoperational environmental conditions of the station are listed in table 1-1.

TABLE 1-1. ENVIRONMENTAL CONDITIONS

CONDITION	OPERATIONAL		NONOPERATIONAL	
	MINIMUM	MAXIMUM	MINIMUM	MAXIMUM
Temperature	59°F (15°C)	90°F (32.2°C)	50°F (10°C)	95°F (35°C)
Humidity	35%	70%	20%	80%
Altitude	-1000 ft (-305m)	10,000 ft (+3048m)	-1000 ft (-305m)	+15,000 ft (+4572m)

*See schematic 62190400. TB4-2 is jumpered to TB4-3 for a nominal 220-vac input (normal factory connection). TB4-2 can instead be jumpered to TB4-1 for a nominal 240-vac input.

TECHNICAL SUMMARY

The following is a brief technical summary of the major features of the display station.

- Alphanumeric display and entry
- 21-inch electromagnetic deflection cathode-ray tube
- Display area — 8 by 8 inches normal mode (12 by 8 inches for maintenance mode)
- Line width — 0.035 inch (maximum)
- Display refresh rate — programmable (50 hertz recommended)
- Display intensity — 0 to 20 foot-lamberts
- Addressable display positions —
 - 512 on X axis } for each presentation
 - 512 on Y axis }
- Maximum symbols per display presentation —
 - 64 symbols per line by 64 lines per raster (small)
 - 32 symbols per line by 32 lines per raster (medium)
 - 16 symbols per line by 16 lines per raster (large)
- Symbols — program-controlled
- 50-key alphanumeric keyboard
- Input/output —
 - Standard 6000 computer voltage levels: logical 1 is +0.2v and logical 0 is +1.2v
 - Maximum total signal cable length of 70 feet
- Maintainability — simplified by pluggable and easily accessible assemblies
- Power
 - 50 Hz, 1 phase, 220 or 240 vac*
 - 60 Hz, 1 phase, 120 vac*
 - 400 Hz, 3 phase, 208 vac

* The station requires 50- or 60-Hz power, not both (see schematic 62190400).

SECTION 2

OPERATION AND PROGRAMMING

This section provides operation and programming information necessary for the effective use of the display station.

OPERATION

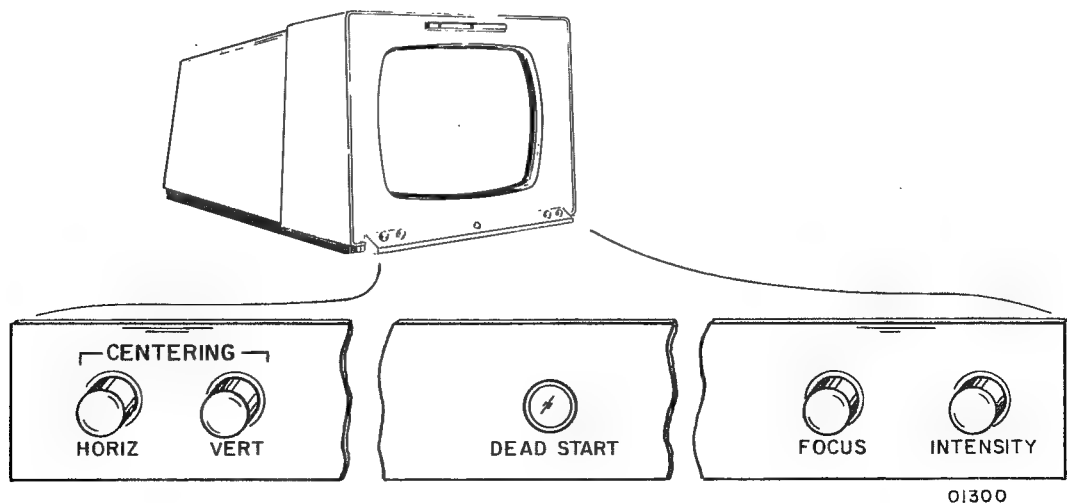
Operating information divides into two areas: operator controls and maintenance controls and indicators.

OPERATOR CONTROLS

Operator controls permit adjustment of the visual display and transmission of input data to the computer from the alphanumeric keyboard.

Monitor Controls

Monitor controls, figure 2-1 adjust display position and appearance. HORIZ (horizontal) and VERT (vertical) CENTERING controls adjust the relationship of the display raster to the edges of the crt. FOCUS adjusts display clarity while INTENSITY adjusts overall brightness. DEAD START enables the operator to dead start the computer in a particular operating sequence.



01300

Figure 2-1. Monitor Controls

Alphanumeric Keyboard

The alphanumeric keyboard, figure 2-2, provides the operator with data entry capability. Pressing a key sends a unique 6-bit octal code, see table 2-1, to the computer. With all keys released, the computer receives an octal code of 00 on the keyboard lines. Simultaneous depression of more than one key results in a logical OR combination of the individual key codes. Following are two examples of simultaneous key depression:

Example 1:

Symbol = A Code = 01

Symbol = M Code = 15

Resulting Symbol = M Code = 15

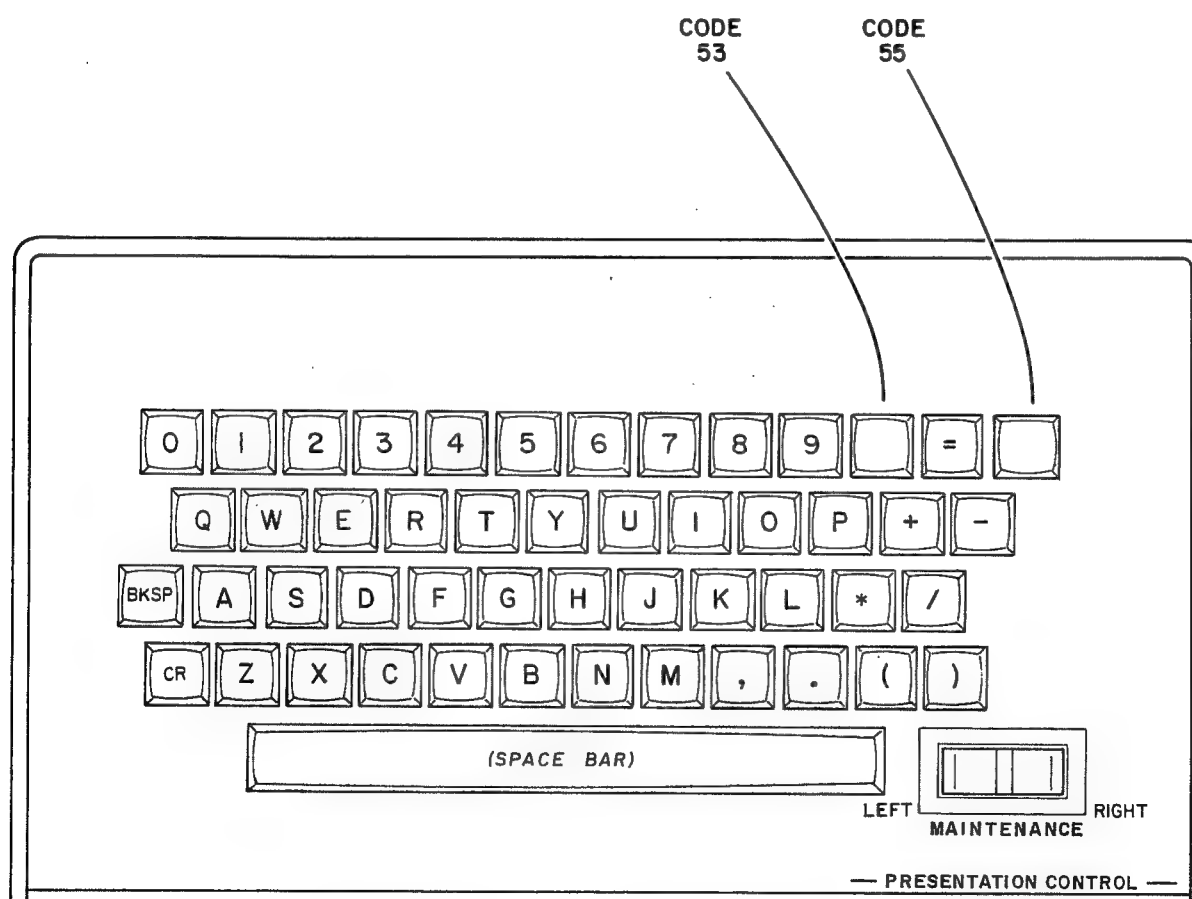
Example 2:

Symbol = B Code = 02

Symbol = M Code = 15

Resulting Symbol = O Code = 17

The computer outputs two alternate, nonrelated data streams, and the three-position rocker PRESENTATION switch enables the operator to select the left, right, or both (maintenance mode) pages for display.



01301

Figure 2-2. Alphanumeric Keyboard

TABLE 2-1. ALPHANUMERIC KEY CODES

OCTAL CODE	SYMBOL	OCTAL CODE	SYMBOL
00	(no data)	32	Z
01	A	33	0
02	B	34	1
03	C	35	2
04	D	36	3
05	E	37	4
06	F	40	5
07	G	41	6
10	H	42	7
11	I	43	8
12	J	44	9
13	K	45	+
14	L	46	- (minus)
15	M	47	*
16	N	50	/
17	O	51	(
20	P	52)
21	Q	53	(note 1)
22	R	54	=
23	S	55	(note 2)
24	T	56	,
25	U	57	. (period)
26	V	60	CR (carriage return)
27	W	61	BKSP (backspace)
30	X	62	(space)
31	Y		

Notes:

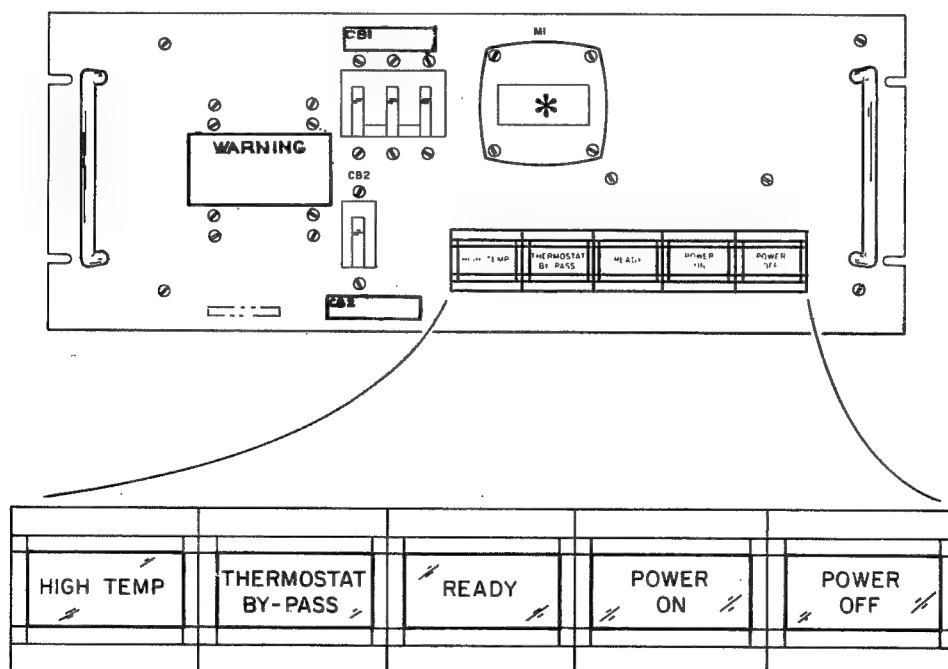
- 1) Code 53 is produced when the eleventh key, top row is pressed
- 2) Code 55 is produced when the thirteenth key, top row is pressed

MAINTENANCE CONTROLS AND INDICATORS

Maintenance controls and indicators appear on the power control panel, the ± 20 -volt power supply, and the deflection/crt supply.

Power Control Panel

The power control panel, see figure 2-3, contains maintenance controls and indicators which enable on/off and thermal condition control and indication. Where used, a running time meter shows the on-time of the station. The power control panel receives power from 60-Hz or 50-Hz and 400-Hz sources and routes it to the ± 20 -volt supply, the deflection/crt supply, and the blowers. It also routes power from the ± 20 -volt power supply to the deflection/crt supply and to the deflection amplifier high-temperature thermostats. Table 2-2 lists and describes the power panel controls and indicators.



01302-1

* METER ILLUSTRATION NOT APPLICABLE AND NOT USED ON ALL POWER CONTROL PANELS.

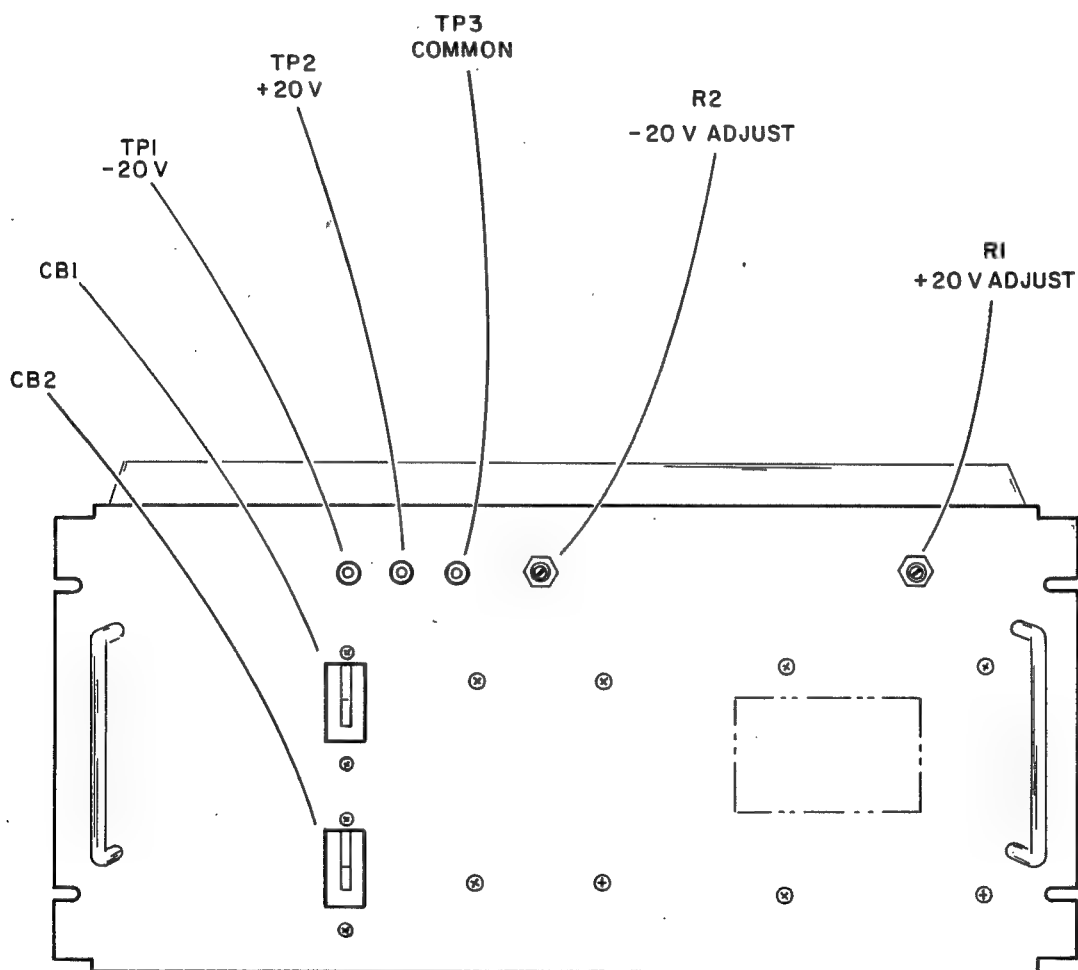
Figure 2-3. Power Control Panel

TABLE 2-2. POWER CONTROL PANEL DESCRIPTIONS

NAME	TYPE	FUNCTION
M1	Time meter	Where used, records time station power has been on.
HIGH TEMP	Indicator	Indicates an internal deflection amplifier temperature of 190°F (87°C) or greater. This turns off the high-voltage power supply immediately. After 15 seconds, the deflection/crt power supply turns off. When the temperature drops to 170°F (76°C) or below, the deflection/crt power supply turns on. After an additional 15-second delay, high voltage is applied to the crt.
THERMOSTAT BY-PASS	Alternate action switch/indicator	Overrides the deflection amplifier high-temperature thermostats, allowing continued visual display. Lights when selected.
READY	Indicator	Indicates that the high-voltage supply is on and the station is ready for display.
POWER ON	Momentary switch/indicator	Turns on station power and illuminates. High voltage does not turn on until 15 seconds after pressing POWER ON.
POWER OFF	Momentary switch	Turns off the high-voltage supply immediately but imposes a 15-second delay before turning off the remaining power supplies.
CB1	3-pole circuit breaker	Controls application of 400-Hz, 208-volt 3-phase power to the station power supplies.
CB2	1-pole circuit breaker	Controls application of 50-Hz or 60-Hz, single-phase power to control relays, running time meter, and blowers.

± 20-Volt Power Supply

Outputs from the ± 20-volt supply, shown in figure 2-4, furnish power to the circuit cards in the d/a chassis, the feedback amplifiers, the deflection amplifier, the power control panel, the high-voltage power supply via the deflection/crt supply, and the symbol yoke on the crt. Circuit breakers CB1 and CB2 control application of 400-Hz, 120-volt, single-phase power to the + 20-volt and - 20-volt sections of the supply, respectively.



01303

Figure 2-4. ± 20-Volt Power Supply

Deflection/CRT Power Supply

In addition to providing two +40-volt outputs for the X and Y position yoke windings, the deflection/crt supply, shown in figure 2-5, provides operating potentials for the crt. Also, the deflection/crt supply controls high-voltage power supply turn-on. Circuit breaker CB1 enables application of 400-Hz, 208-volt, 3-phase power from the power control panel to the deflection/crt power supply. Circuit breakers CB2 and CB3 protect the +40-volt outputs feeding the X and Y crt position yoke windings, respectively.

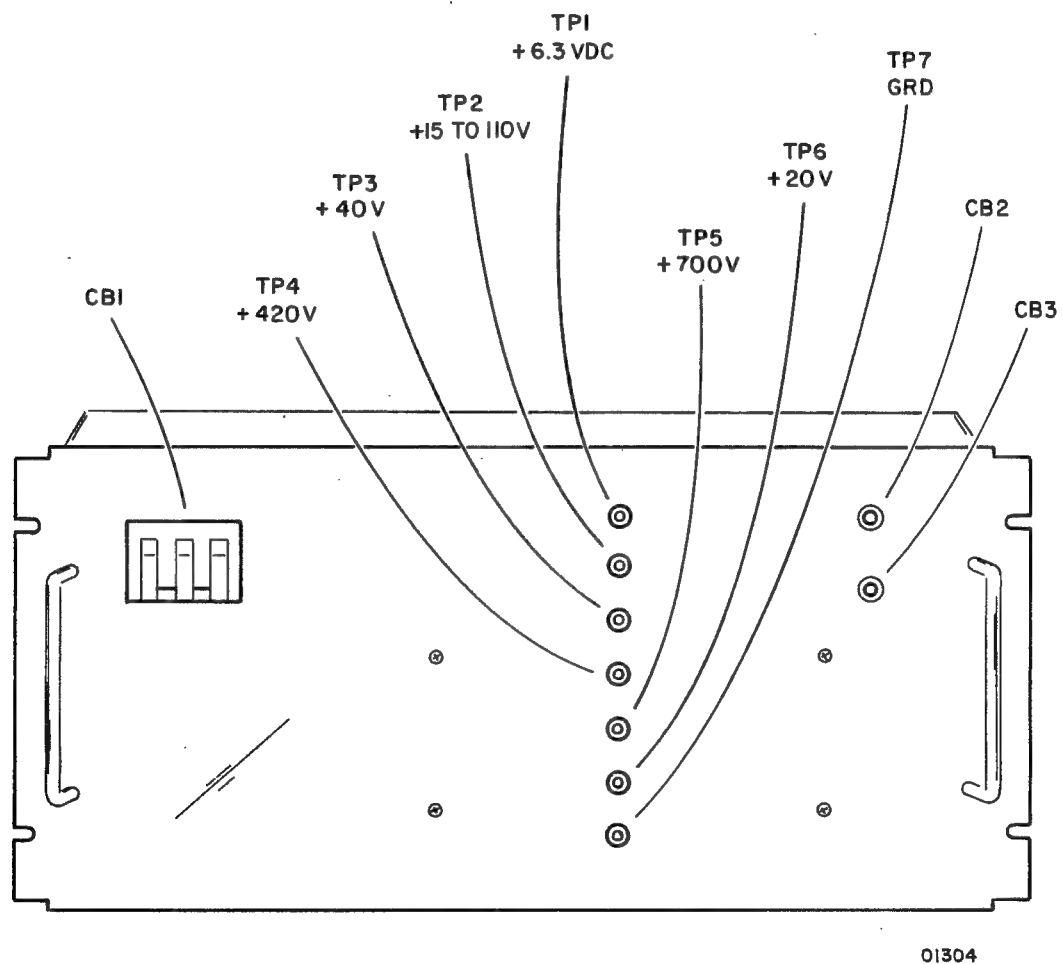


Figure 2-5. Deflection/CRT Power Supply

PROGRAMMING

The following paragraphs explain data words received from the computer via the controller and program control of display refresh.

DATA WORDS

The computer controls the display of symbols at specified points within the 8-inch by 8-inch crt raster area (8 by 8 = normal mode — 12 by 8 = maintenance mode).

Data words from the computer control symbol positioning and display. The 9-bit X-position word (10-bit X position in maintenance mode) and 9-bit Y-position word together establish the base position coordinate (the center of the symbol matrix), and the X- and Y-analog symbol signals combined with the unblank signal paint the symbol.

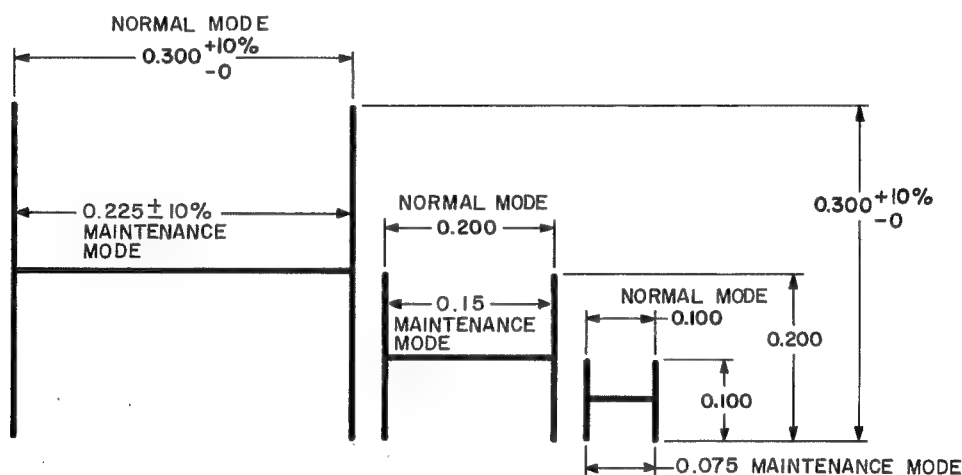
Position Words

Prior to displaying a symbol, the computer program places 9-bit X- and Y-position words on the output channel feeding the station. These words provide for (000-777 octal) coordinates along the X and Y axes. As explained in Section 1, the resulting symbol center is at the junction point of the X and Y coordinates. The X- and Y-position words must remain on the output channel until completion of the symbol painting. The Screen Select signal from the controller is employed as the highest order X-position bit in maintenance mode. This Screen Select signal is ignored in normal mode.

After selecting a new base position and prior to initiating symbol display (symbol painting), a programmed settling time delay must be initiated. Settling time allows the crt electron beam to stabilize at the new position. The maximum settling time for positioning to any point on the raster is 10 microseconds for an 8- by 8-inch raster and 14.2 microseconds for a 12-inch by 8-inch raster. The approximate time to generate a symbol is 2.5 microseconds. The computer generates two symbols per 12-bit data word from the data source. The controller must allow 1.6-microsecond delay after drawing the first symbol to allow the crt beam position to settle before drawing the second symbol. Gross deflection settling time can be related to the distance the beam moves by the following formula: settling time = 10^{-6} seconds + 1.1×10^{-6} seconds per inch of beam movement.

Symbol Painting

After base positioning, a symbol is painted by means of inputs on the symbol analog signal lines in conjunction with the unblank signals. The three possible figure size measurements are shown in figure 2-6. The program controls the type and size of symbols by specifying beam movement (stroke) within the symbol matrix and unblanking the beam for visible moves. Symbol shape and settling time delays are determined by the controller. Symbol complexity, strokes required to paint a symbol, dictates the number of symbol moves required. Observe the following rules for symbol painting:



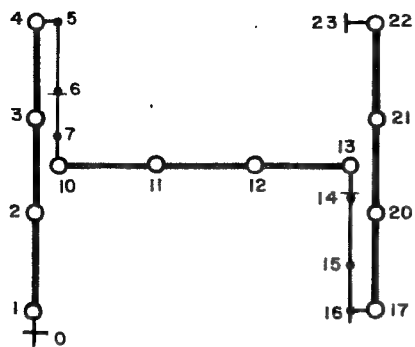
NOTE:
ALL MEASUREMENTS ARE IN INCHES ($\pm 10\%$) EXCEPT FOR LARGE SIZE CHARACTERS. TOLERANCE ON THE LARGE SIZE CHARACTER SHALL BE $^{+10\%}_{-0}$.

01305-2

Figure 2-6. Symbol Relationships

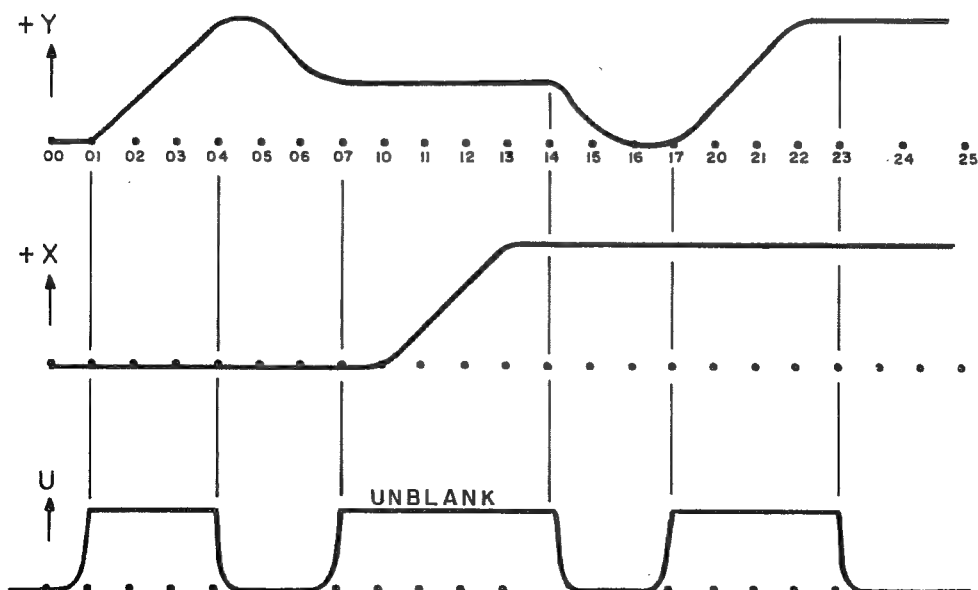
- Unblank the beam only when moving the beam for visible symbol strokes.
- Always blank the beam after the last symbol stroke.
- To maintain uniform intensity within a symbol, all strokes should be the same length.

Figure 2-7 shows the sequence of strokes used for painting the symbol "H".



V_1 = SINGLE VERTICAL MOVE
 V_2 = DOUBLE VERTICAL MOVE
 H_1 = SINGLE HORIZONTAL MOVE
 H_2 = DOUBLE HORIZONTAL MOVE
 U = UNBLANK (ALTERNATELY ON/OFF)
 $V_1 \bullet V_2$ = REVERSE VERTICAL DIRECTION
 $H_1 \bullet H_2$ = REVERSE HORIZONTAL DIRECTION

H	IO				
T	V ₁	V ₂	H ₁	H ₂	U
00					X
01		X			
02		X			
03		X			
04	X	X			X
05		X			
06	X				X
07					
10				X	
11				X	
12				X	
13					
14		X			X
15	X				
16	X	X			X
17		X			
20		X			
21		X			
22					
23					X
24					
25					



01359

Figure 2-7. Symbol Painting Example

REFRESH RATE

To ensure a flicker-free display of uniform intensity and prevent damaging the crt phosphor, a 50-Hz refresh rate should be maintained. Refresh rate is the reciprocal of the time between consecutive unblanking of the same point on the crt display raster. Decreasing the refresh rate decreases display intensity and causes flicker. Increasing the refresh rate increases display intensity.

CAUTION

If the refresh rate is much faster than 50 Hz, the crt phosphor may be damaged.

Figure 2-8 illustrates program control of display refresh.

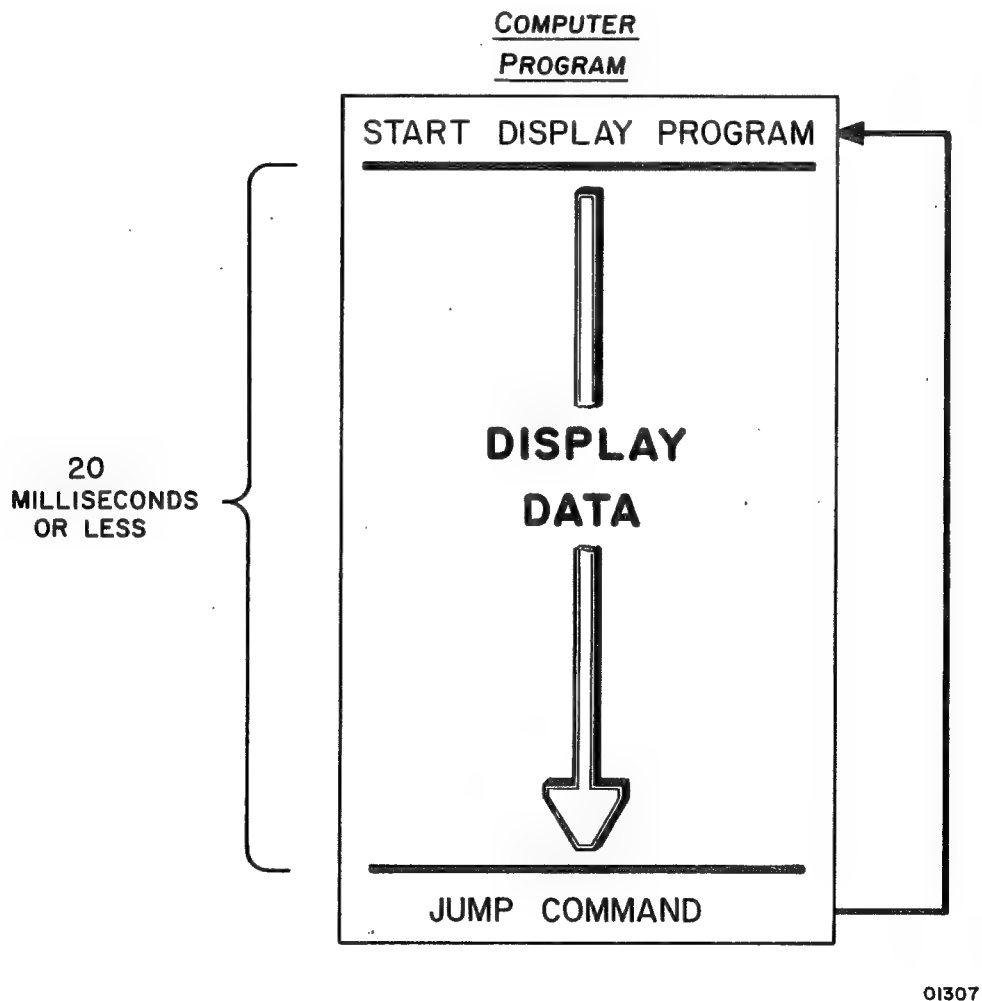


Figure 2-8. Program Refresh Control

SECTION 3

INSTALLATION AND CHECKOUT

This section contains all information required to initially install and check out the station plus packing instructions for reshipment.

SITE REQUIREMENTS

The site must meet the physical, environmental, and electrical requirements specified in Section 1 of this manual. Station maintenance requires 3 feet of clearance on all sides of the unit.

To facilitate the use of test equipment during periods of maintenance, Control Data requires that a convenience outlet be available within 15 feet (5 meters) of each system component cabinet. The outlets may be located in the walls or raised floor panels of the computer room and must not be obstructed by storage racks or other furniture. The receptacles shall be of the single-phase grounded type, installed according to local electrical codes. For 60-hertz installations, the nominal voltage shall be 120 volts. For 50-hertz installations, the nominal voltage shall be 220 or 240 volts, as dictated by the single-phase power available at the site.

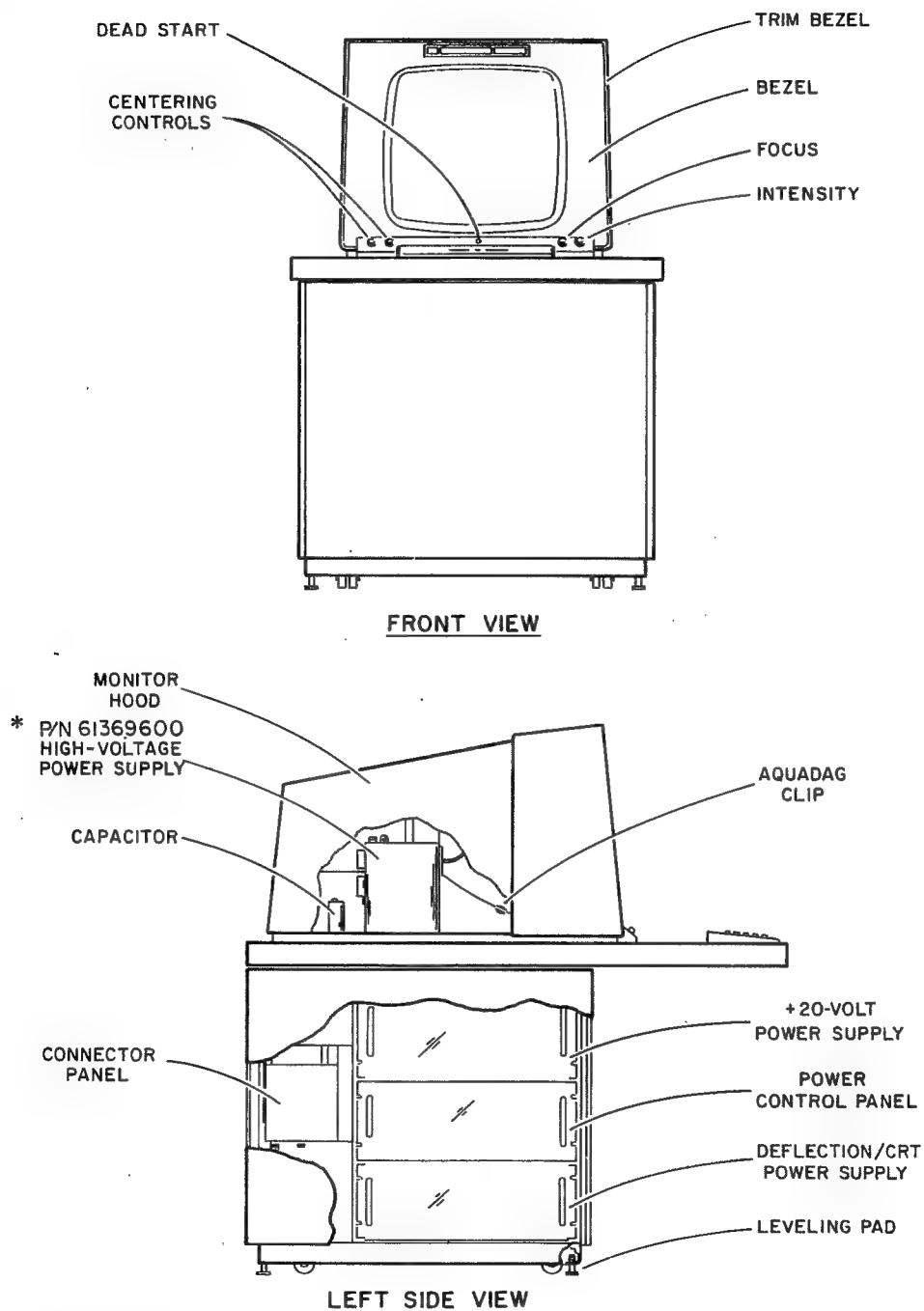
In addition to normal specified system power and grounding requirements, the following grounding and shielding is required for a CDC CYBER 170 system installation. All power and control cable runs must be shielded and the shielding must be grounded. The following types of shielding are acceptable:

- Totally enclosed conductive busways
- Steel thin-walled metallic conduit
- Flexible metallic conduit
- Braided metallic-shielded jacketing
- Zip-on flexible metallic-shielded jacketing (for example, Zippertubing*)

* Registered trademark of the Zipper Tubing Co., Los Angeles, California.

INSTALLATION AND CHECKOUT

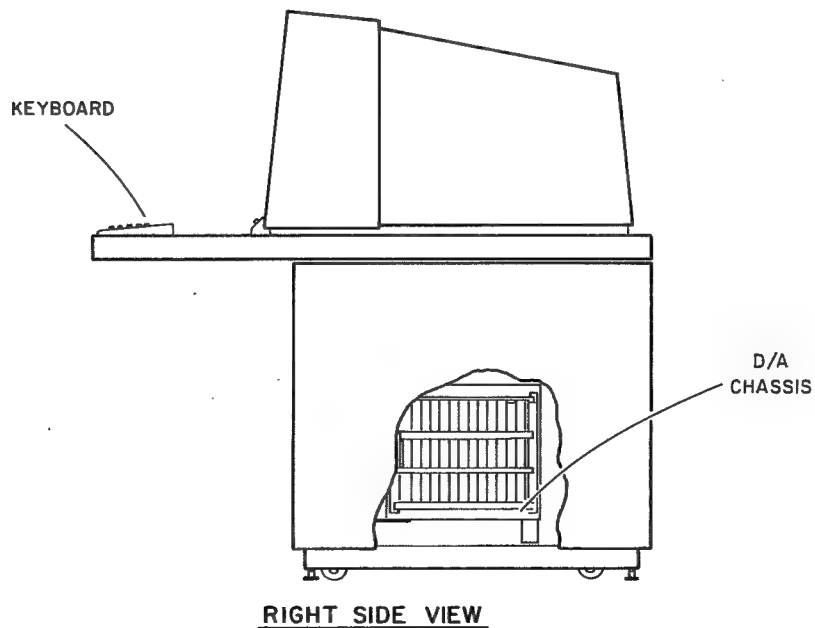
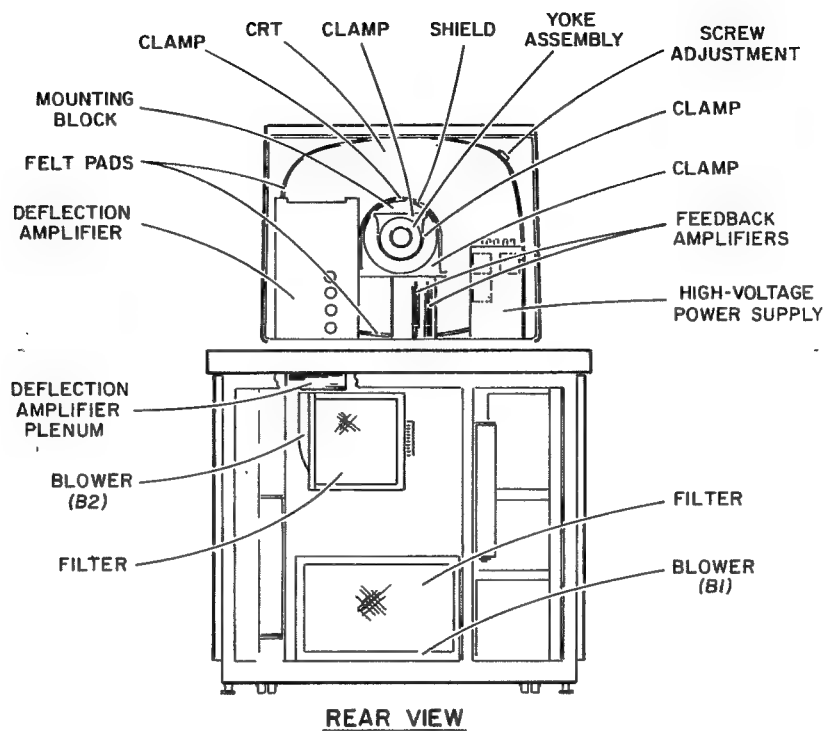
The procedure outlined on following pages contains all the steps required for installation and checkout of the station. Figures 3-1 and 3-2 call out the location of all assemblies and may be used for reference throughout the procedure.



* REPLACEMENT POWER SUPPLY, P/N 51918275 NOT SHOWN, BUT IT IS INSTALLED IN SAME LOCATION AS P/N 61369600 POWER SUPPLY.

01308-1

Figure 3-1. Display Station Front and Left Side Views



01309

Figure 3-2. Display Station Rear and Right Side Views

- 1) Remove the polyethylene sheet covering the station by cutting the Avis straps holding it in place.
- 2) Remove the cardboard covering the station workshelf and keyboard.
- 3) Take off the side and rear panels.
- 4) Remove the masking tape securing the deflection amplifier blower and main chassis blower filter.
- 5) Remove the masking tape holding the cards in the d/a chassis. Seat all the cards. See that all power supply and d/a chassis cables are tight.*
- 6) Move the station into position and adjust leveling pads.

NOTE

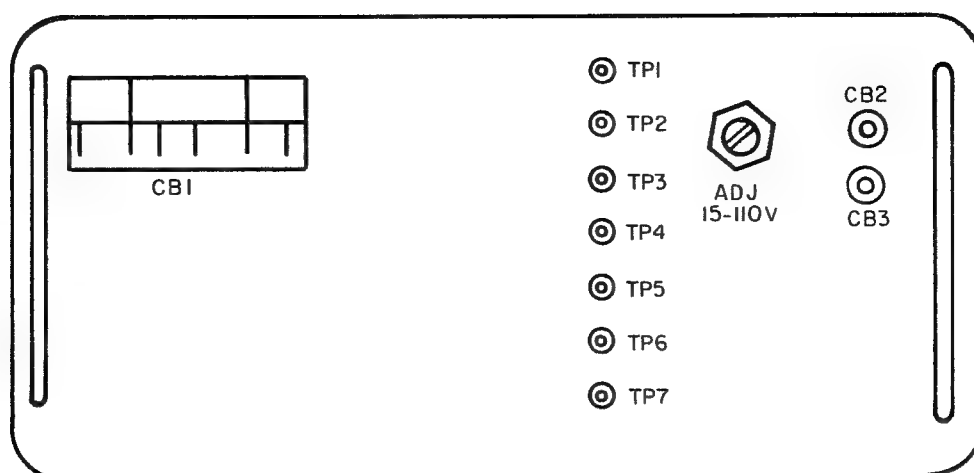
The equipment leveling pads must be immediately lowered to the floor for stability after unpacking and positioning.

- 7) Remove the monitor hood by sliding it toward the back of the station.
- 8) Remove the tape holding the feedback amplifier cards in place and tighten all cables.

CAUTION

Rotate the +15 through 110-volt adjustment potentiometer on the deflection/crt power supply (figure 3-2.1) fully clockwise to prevent damage to the crt screen when turning on power. Failure to do this prior to turning on power could result in permanent damage to the phosphor coating on the face of the crt.

* To keep A/N connectors from freezing, snug them down tight and back off 1/8 of a turn.



03359

Figure 3-2.1. Deflection/CRT Power Supply

- 9) Place station circuit breakers in the following states:
 - ± 20 -volt supply — CB1 and CB2 on.
 - Deflection/crt supply — CB1 on.
 - Power control panel — CB1 and CB2 off.
- 10) Connect station power and signal cables as shown in figure 3-3.
- 11) Turn on the 50- or 60-Hz and 400-Hz power. Check the voltage inputs at TB1 and TB2 on the connector panel.
- 12) Turn on CB1 and CB2 on the power control panel and press POWER ON.
- 13) Using the maintenance procedures in Section 6, of this manual, check all power supply outputs (excluding +15- to +110-volt output of deflection/crt supply) and adjust if necessary.
- 14) Measure the +15- to +110-volt output of the deflection/crt supply and adjust for a maximum output (clockwise rotation).
- 15) Rotate the intensity control on the console to minimum position or fully counterclockwise.
- 16) Slowly decrease (counterclockwise rotation) the +15- to +110-volt output of the deflection/crt supply until a spot appears on the crt. Increase the voltage until the spot just extinguishes and adjust intensity control on console for comfortable viewing.
- 17) Replace the monitor hood, side, and rear panels.
- 18) Run diagnostic programs and refer to Section 6, Maintenance for correction of any problems.

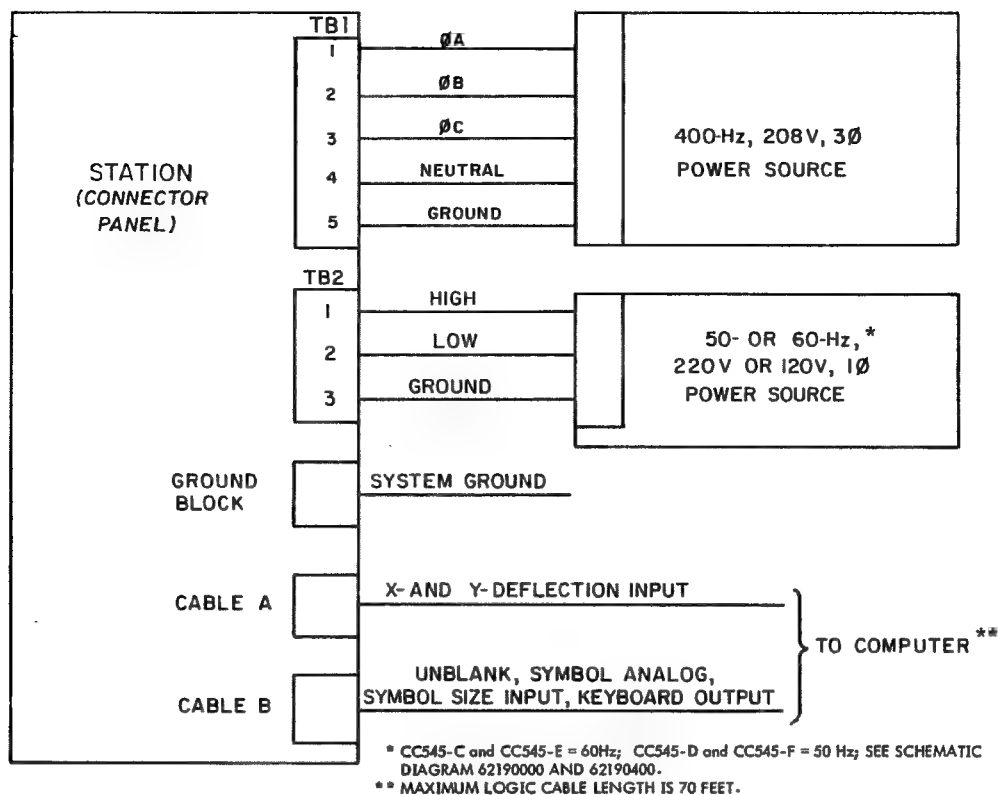


Figure 3-3. Cabling Diagram

PACKING INSTRUCTIONS

Preparing the display station for shipment includes disconnecting cables and leads and securing certain parts and assemblies (internal preparations). In addition, protective material and strapping must be placed around the exterior of the unit (external preparations). There are two methods of shipping the display station — by van or by air. The method of shipment determines the specific external preparations procedure. The first part of packing instruction procedure defines internal preparations that are common to both methods of shipment. Refer to corporate packaging specification 59104500.

INTERNAL PREPARATIONS

Prior to packing the station for shipment, turn power off, remove the side panels, remove the rear panel, and remove the monitor hood. Refer to figures 3-1 and 3-2 for assembly locations.

- 1) Turn off the 50- or 60-Hz and 400-Hz power inputs to the station. Use a multimeter and verify the absence of any voltage.
- 2) Disconnect all power and signal input cables.
- 3) Using a multimeter and high-voltage probe, discharge the post accelerator output of the high-voltage supply.
- 4) Secure the feedback amplifier cards to their chassis with masking tape.
- 5) Place masking tape over the cards in the d/a chassis.
- 6) Tape the deflection amplifier and main chassis blower filters in place.

EXTERNAL PREPARATIONS

The first three external preparations are common to both van and air shipments. The number of the instruction is the same as the callout number on figures 3-4 and 3-5.

- 1) Screw up leveling legs.
- 2) Cover keyboard with 1- by 10- by 14-inch urethane foam and secure with nonmetallic strapping around the table.
- 3) Install dust cover (41002105).

Van Shipment

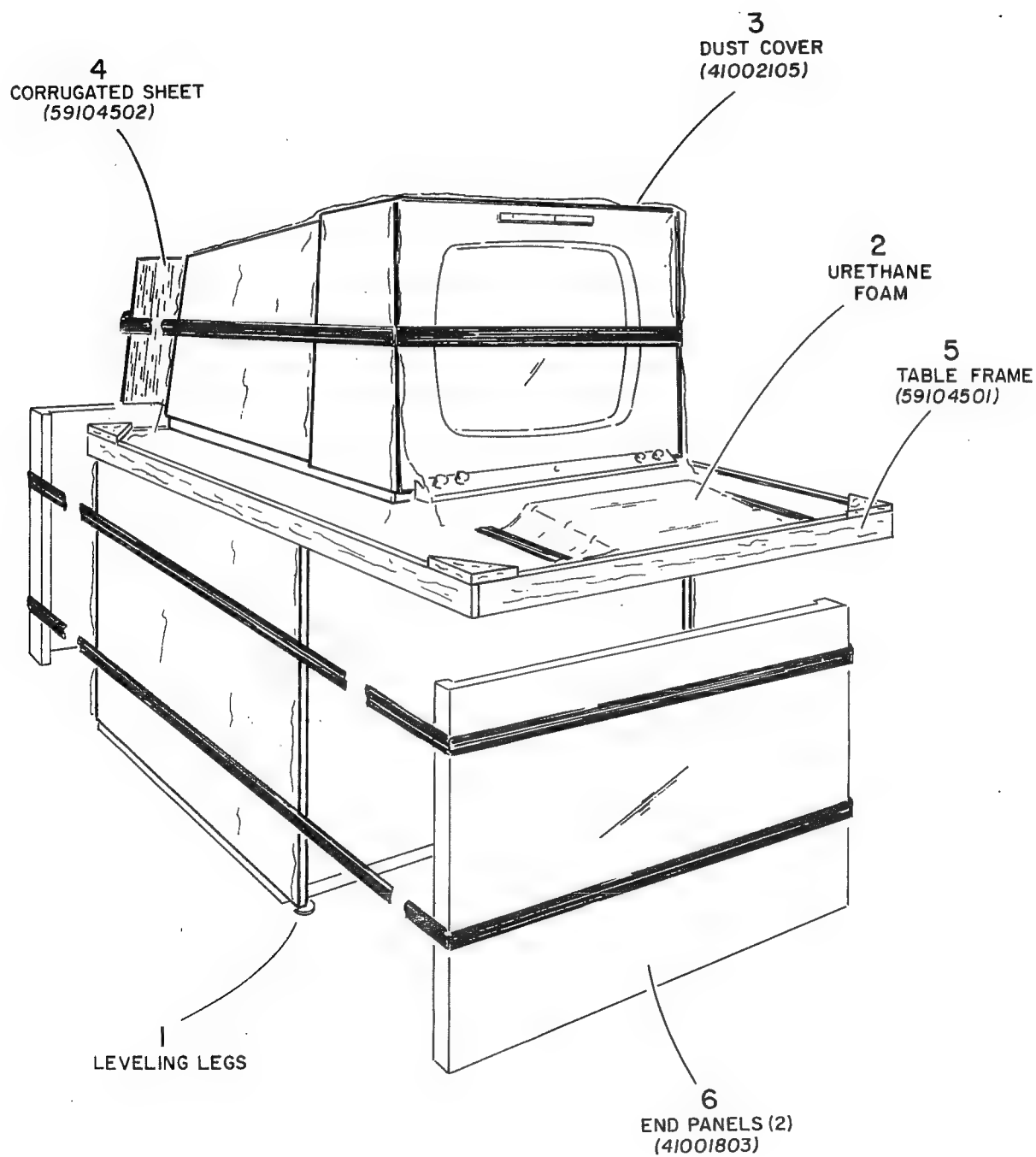
The following three steps apply to van shipment only (figure 3-4).

- 4) Install a 22-1/4-inch corrugated sheet (59104502) on rear of hood and secure to the hood with nonmetallic strapping.
- 5) Install wood table frame (59104501), using cellulose cushioning to protect painted surfaces from wood and strapping.
- 6) Install two 24-inch end panels (41001803) and secure with nonmetallic strapping.

Air Shipment

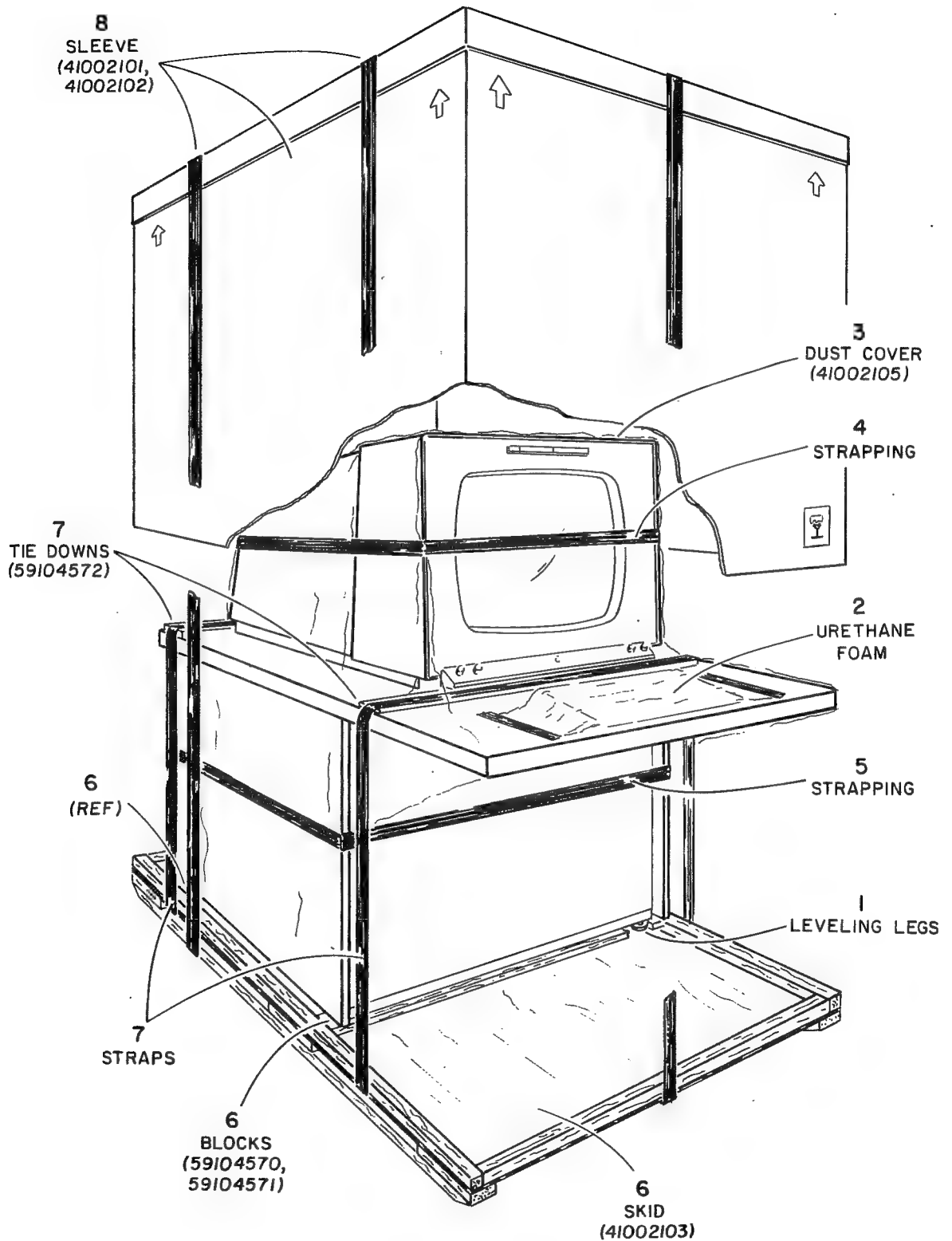
The following five steps apply to air shipment only (figure 3-5).

- 4) Secure the hood with nonmetallic strapping.
- 5) Secure frame with nonmetallic strapping.
- 6) Nail two blocks (59104570,1) securely to skid (41002103).
- 7) Mount console on skid and add the two tie downs (59104572). Secure with two steel straps.
- 8) Add sleeve (41002101,2) and strap in three places.



01311

Figure 3-4. Packing, Van Shipment



01312

Figure 3-5. Packing, Air Shipment

THEORY OF OPERATION

The diagram illustrates the control system for the IBM 7090 computer. It features a central horizontal bar labeled "CABLE CONNECTORS A,B" which receives input from a "DATA SOURCE". Below this bar, several components are connected via numbered lines (circles with numbers):

- Line 4 connects to "UNBLANK CONTROL AND LINE DRIVERS".
- Line 2 connects to "PROGRAMMED SYMBOL SIZE CONTROL".
- Line 1 connects to "DEAD START".
- Line 2 connects to "X SYMBOL ANALOG INTERFACE".
- Line 2 connects to "Y SYMBOL ANALOG INTERFACE".
- Line 9 connects to "Y POSITION INTERFACE".
- Line 10 connects to "X POSITION INTERFACE".
- Line 8 connects to "KEYBOARD".

The "X SYMBOL ANALOG INTERFACE", "Y SYMBOL ANALOG INTERFACE", "Y POSITION INTERFACE", and "X POSITION INTERFACE" all feed into a "D/A CONVERTER AND SUMMING" block. The "PROGRAMMED SYMBOL SIZE CONTROL" block also feeds into this "D/A CONVERTER AND SUMMING" block. The output of the "D/A CONVERTER AND SUMMING" block goes to a "DEFLECTION" block. The "DEFLECTION" block outputs line 4 to the "CRT DISPLAY". The "UNBLANK CONTROL AND LINE DRIVERS" block outputs line 2 to the "CRT DISPLAY".

4-1

The d/a circuitry receives all control and data information in digital and analog form from the data source. Digital information controls the base position coordinates at which symbols are to be displayed, the size of the displayed symbols, and crt unblanking (left and right presentation). Analog levels control crt beam movement to form a symbol. Preamplifier circuits amplify symbol formation analog levels as well as position coordinates and unblank level (intensity) after they are converted to analog voltages. Both positive and negative X and Y deflection values are applied to the deflection amplifier for push-pull type X and Y deflection. The deflection amplifier output drives the crt deflection plates which position the crt beam. Each beam movement depends on the sum of the outputs of the two analog sources: positioning and symbol.

POSITIONING SEQUENCE

The controller transfers digital positioning information via coax cables. Changing the state of the lines distinguishes between logical 1's and 0's. The logic lines are terminated by 619 cards. The 619 is a switching circuit and level shifter which enables the matching of the 72-ohm line to the display station logic. A 0 input to the 619 card causes the -0.5-volt output from pin 4 (8 or 12) and -3.0 volts from pins 2 (7 or 11).

The level translators (619's) in conjunction with the d/a converters (002's) act as resistor-selector switches (see figure 4-2). An enabled 002 card (closed switch) applies the d/a voltage to the associated resistor in the d/a resistor network (027 or 4DMD cards) while a disabled 002 card (open switch) grounds the associated d/a resistor.

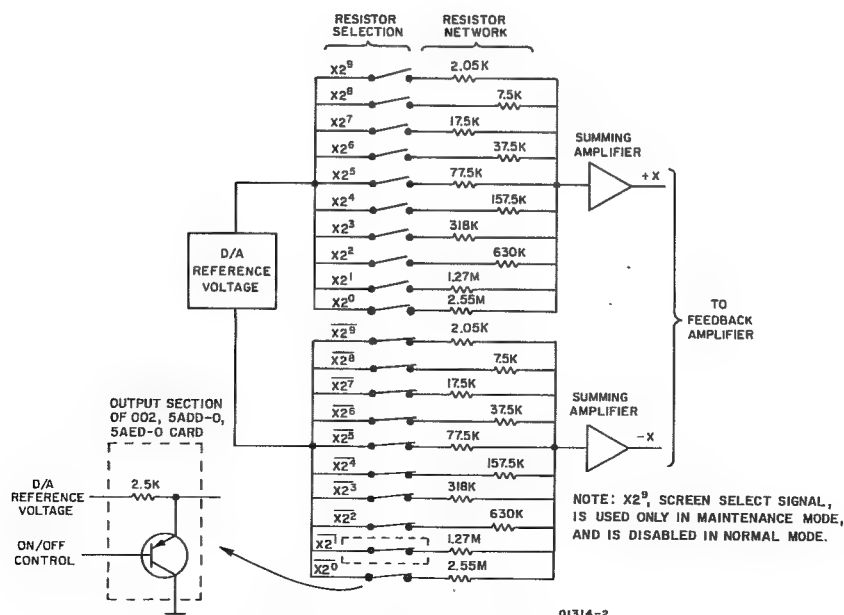


Figure 4-2. Selection-Resistor Network

The resistors in the d/a resistor network (027 and 4DMD cards) are weighted by powers of 2 with the exception of $X2^9$ which is used in maintenance mode to generate the 0.5-inch space between presentations. The lower order bits specify smaller positioning increments than do the higher order bits so resistor values decrease from the 2^0 bit to the 2^8 bit. By associating level translator "true" outputs with one resistor group (4DMD-A14 for +X) and "false" outputs with another (4DMD-A15 for -X), the resistors develop push-pull current inputs to the +X (4DND-A13) and -X (4DND-A16) summing amplifiers. The summing amplifiers take the algebraic sum of base positioning currents and combine them into a single variable current. The output voltage of the current summing amplifiers reflects the magnitude of the current input to pin 1 of the 9BJD card from the associated d/a resistor network (4DMD card). Input current ranges from 0 to approximately 2 milliamperes, and corresponding changes in the output voltage range from -2 volts to 0 volt). Increased input current causes the output voltage to go more positive, while decreased input current causes the output voltage to go less positive. The current summing amplifiers supply push-pull voltage levels to the feedback amplifier (0AGD card). The 0AGD feedback amplifier provides current amplification for driving the X-, 7-positioning circuitry of the deflection amplifier. For normal mode, summing and feedback amplifier outputs correspond to crt beam position as follows (for maintenance mode see logic diagram 62196900, sheet 2):

+X Summing Amplifier	-X Summing Amplifier	Feedback Amplifier		Beam Position
		Pin 4	Pin 44	
-2 volts	0 volt	+6 volts	0 volts	Left
-1 volt	-1 volt	+3 volts	+3 volts	Center
0 volt	-2 volts	0 volt	+6 volts	Right

The normal output at pins 4 and 44 of the 0AGD card swings 2.5 volts (± 0.5) around a +4-volt dc level while in maintenance mode the swing is ± 3 volts around a 4 vdc level. The 0AGD also receives negative feedback voltage from the deflection amplifier (pins 16 and 36) which is 180 degrees out of phase with the differential amplifier. This stabilizes the amplifier and improves frequency response.

The deflection amplifier provides push-pull current outputs for two horizontal deflection coils on the crt neck. As current increases in one coil, it decreases in the other. The resulting imbalance in the two magnetic fields moves the electron beam towards the weaker field, thus repositioning the beam. This establishes the base position coordinate. This position is modified by the symbol deflection values which are used in conjunction with unblank to paint a symbol.

SYMBOL DEFLECTION

The four analog signal inputs (left, right, down, up) are terminated by 620 cards. A 620 card is a linear amplifier and level shifter which enables the matching of a 72-ohm line to the display station logic. The input to the 620 card is 0 to +5 volts, and the output is from 0 to -3 volts. The outputs from the 620 cards, attenuated by the symbol size control circuitry (016 cards), go to the symbol deflection amplifier drivers (4ALD and 5AHD-0 cards).

The 016 cards receive their inputs from the symbol size signal lines. The system enables the selection of three character sizes: large, medium, and small. A logical 1 on either medium or small will select that size, while logical 0's on both medium and small will select the large size. For the large size, the 016 cards are all disabled and the greatest amount of current is allowed to pass to the symbol deflection (4ALD and 5AHD-0) cards. A logical 1 on a symbol size signal line will turn on the associated transistors of the 016 card, and the resistance provided by the setting of the 016D potentiometers determines the amount of current that is output to the symbol deflection amplifier.

The 4ALD and 5AHD-0 symbol deflection amplifier/drivers output to the deflection amplifier. The deflection amplifier provides current amplification of symbol inputs and applies this information to the symbol yoke. The symbol position amplifiers receive push-pull outputs from the 4ALD and 5AHD-0 cards. A change in input voltage at the 2 (+) or 3 (-) pin is accompanied by an equal voltage change of opposite polarity on the other input pin. The input emitter-follower provides input isolation and current gain to drive the four parallel emitter-followers comprising a symbol amplifier output stage. The four parallel emitter-followers provide the necessary current-handling capability for yoke current. As amplifier input voltage becomes more positive, yoke current increases and vice versa. Current for symbol deflection is much lower than for positioning because smaller beam movements are required. The magnetic fields produced by the symbol yoke modify those produced by the position yoke to paint symbols.

UNBLANK

Unblank signals received from the controller are input to the unblank receivers (4AMD cards). The unblank receiver provides impedance matching for the incoming signal. The 4AMD card has 100-ns delay line which is tapped in 10-nanosecond increments to allow for the proper alignment between the unblank pulse stream and the analog symbol deflection symbols. The timing relationship between the unblank pulse and the analog symbol deflection symbol should be such that the unblank signal reaches 90 percent of its peak amplitude just as the deflection signal starts to move the beam for a stroke to be displayed. The 4AMD card also provides the level shifting required to interface to the 207 card. The 207 card is the unblank timing and shaping circuit. The unblank signal received from the 4AMD card is modified by the input from the symbol intensity amplifier (4AND card) and fed to the crt control grid for unblanking the electron beam during symbol painting.

Since there are different symbol sizes, the unblank intensity changes: the large size requires the greatest intensity because of the longer moves required and the small size requires the least intensity because of the shorter moves. The symbol size select signal lines are terminated by 619 cards (logic line terminators), and input to the 4APD-1 (symbol intensity modulator card) via 1222RS special-purpose inverters. A logical 1 on the medium or small size signal line selects corresponding variable attenuators which determine the symbol size. Logical 0's on both lines select the large size. (Note: Logical 1's on both lines would create a symbol which would be smaller than standard size and which could be illegible.) The 4APD-1 circuitry allows the three possible symbol size sections to independently modulate the symbol intensity level. There is an overall intensity adjustment capability which affects all three symbol size sections (potentiometer R4) and also individual potentiometers for each of the three size selections. These individual potentiometers are adjusted so that the greatest amount of voltage is allowed to pass for the large size and the least amount for the small size.

The 4APD-1 card outputs to the symbol intensity amplifier (4AND) card. The 4AND card amplifies the size-modulated intensity signal and then applies this signal to the unblank timing/shaping card (207). The 207 card receives the unblank signal from the 4AMD card and the intensity input from the 4AND card. The input from the 4AMD receiver ranges from a logical 0 (-0.5 volt) that enables the unblank operation to a logical 1 (approximately -2.6 volts) that disables unblank. The voltage output from the 4AND card varies from -1.8 vdc to +19.4 vdc. The unblank signal allows the output voltage of the 207 card to rise until clamped by the voltage input from the 4AND card. The resulting pulse from the 207 card feeds the crt control grid, unblanking the crt. The output voltage from the 207 card varies from -15 to +18 volts. The unblank pulse from the 207 goes to the crt control grid by way of the OKGD card which contains an arc-over protect circuit.

KEYBOARD INTERFACE

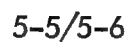
The display station has eight output signal lines: six lines which encode (in binary) the symbol of the keyboard key that is actuated, and two control lines (key up and key down) which indicate to the controller that a keyboard key has/has not been actuated. The 4ABD-1 card provides isolation to isolate the controller keyboard receiver circuits from the 4AJD card. The 4ABD-1 outputs are the same as the keyboard inputs (low or open). The 4AJD keyboard bounce suppressor card suppresses keybounce and also contains a 3-Hz oscillator to enable the repeat key operation. A Schmitt trigger input arrangement is used to suppress keybounce. If the actuated key is held down for 1 to 3 seconds (adjustable), the strobe output will oscillate at a 3-Hz rate to alternately toggle the key up/key down signals.

SECTION 5

DIAGRAMS

This section contains all the cabling, power, logic, and schematic diagrams for the display station. Where pertinent, the back of the page preceding the logic, schematic, and wiring diagrams contains a detailed operational theory on the diagram.





SHEET REVISION STATUS										REVISION RECORD							
											CD	DESCRIPTION	DATE	DATE	CHG	APP	
3	1	1									A	9/15-10	RELEASED CLASS A	—	6/11/78	—	7-7
											B	13097	REVISED PER ECO	NOV 1978	WJ	114	

SHEET NO.	LOGIC REFERENCE NUMBER	REV	LOGIC DIAGRAM TITLE

SHEET NO	CODE REFERENCE NUMBER	REV	LOGIC DIAGRAM TITLE
1		B	LOGIC DIAGRAM CONTROL SHEET
2		C	DEFLECTION, SYMBOL DEFLECTION, AND SYMBOL SIZE LOGIC
3		D	DEFLECTION, RETURN, AND UNGRADE

REFERENCE DRAWING		CONTROL DATA		TITLE	
SEE INSTRUCTIONS	H282000	CC545 C B D		LOGIC DIAGRAM CONTROL SHEET	
UNIT	CH	UNIT	CH	DRAWING NO	
1	1	1	1	62 196900	
DATE		DATE		CROSS CHECK	
11-27-77		11-27-77		15970	
TIME		TIME		DRAFTER	
11-27-77		11-27-77		4-042	
CHECKED BY		CHECKED BY		SCALE	
11-27-77		11-27-77		1	
APPROVED BY		APPROVED BY		SHEET 1 OF 3	
11-27-77		11-27-77			

X DEFLECTION, SYMBOL DEFLECTION, AND SYMBOL SIZE LOGIC

The computer transfers digital positioning and analog symbol signals via coax cables. Changing the state of the coax lines distinguishes between 1's and 0's. Line voltage levels and corresponding current are:

Voltage	Current
0 volt	0 ma
-0.8 volt	20 ma

For gross positioning of the beam, 619 level translators A09 through A11 convert 9-bit X position words to logic levels required by 002 (5ADD and 5AED) cards. True and false outputs enable generation of push-pull deflection signals.

Pins 3 and 4 of each level translator (619) reflect input information as follows:

Pin 3	Pin 4	Input Bit
-0.5 vdc	-3.0 vdc	Logical 0
-3.0 vdc	-0.5 vdc	Logical 1

A -0.5-volt output disables a d/a converter 002 (5ADD and 5AED) and a -3.0-volt output enables a d/a converter. The level translators and d/a converters act as resistor selection switches, see the simplified illustration. An enabled 002 card (closed switch) applies the d/a reference voltage to a resistor. A disabled 002 card (open switch) grounds a resistor. Resistors weighted by powers of two make up the d/a resistor networks. Because low order X position bits specify smaller positioning increments than high order bits, resistor values decrease from the 2⁰ bit to the 2⁹ bit. By associating level translator true outputs with one resistor group and false outputs with the other group, the resistors develop push-pull current inputs to the +X and -X summing amplifiers (4DND). When the input data specifies the horizontal position of the crt, the parallel resistance of resistors associated with X₂₀ through X₂₇ equals that of resistor X₂₉. Increasing the X position above center position increases +X current while decreasing -X current and vice versa. Each +X and -X current combination specifies a unique horizontal crt beam coordinate. Current summing amplifiers (4DND cards) supply push-pull voltage levels to the feedback amplifier (0AGD card). The feedback amplifier controls deflection amplifier output current. Summing and feedback amplifier outputs for normal mode correspond to crt beam position as follows:

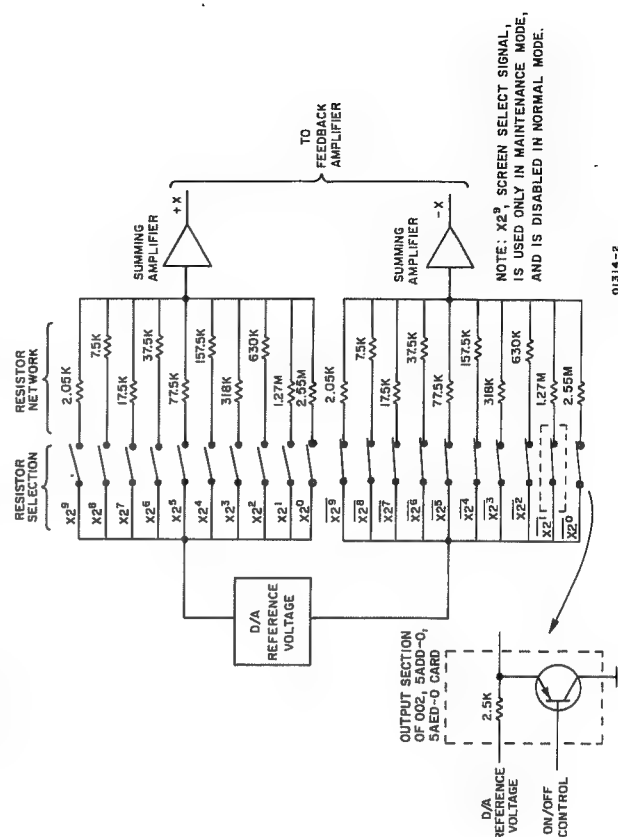
	+X Summing Amplifier	-X Summing Amplifier	Feedback Amplifier Pin 4	Beam Position
	-2 volts	0 volt	+6 volts	Left
	-1 volt	-1 volt	+4 volts	Center
	0 volt	-2 volts	+2 volts	Right

(for maintenance mode 0AGD levels see diagram opposite)

The 1K centering potentiometer balances the push-pull outputs of the feedback amplifier. A gain control potentiometer on the feedback card permits raster size control. A level control potentiometer enables adjustment for operation in the linear region of the feedback amplifier.

The deflection amplifier provides push-pull current outputs for two horizontal deflection coils on the crt neck. As current increases in one coil it decreases in the other. The resulting imbalance in the two magnetic fields moves the electron beam toward the weaker field, repositioning the beam. Feedback signals from the deflection amplifier stabilize amplifier operation and improve frequency response.

The analog symbol signals are input to the analog line terminator (620) cards. The digital symbols size signals, via 619 logic line terminators and 1222RS inverters, are input to the 016-D symbol size control cards. The 016-D cards are used across the symbol lines to modify the output from the 620 cards to the symbol deflection amplifier drivers (4ALD and 5AHD-0) cards to accommodate the length of the moves required to paint the symbol the size chosen (the large size needs the most voltage because of the longer moves used). The 4ALD and 5AHD-0 cards amplify the push-pull signals from the 620 cards (via the 016-D cards) and apply them to the symbol deflection amplifier.



01314-2



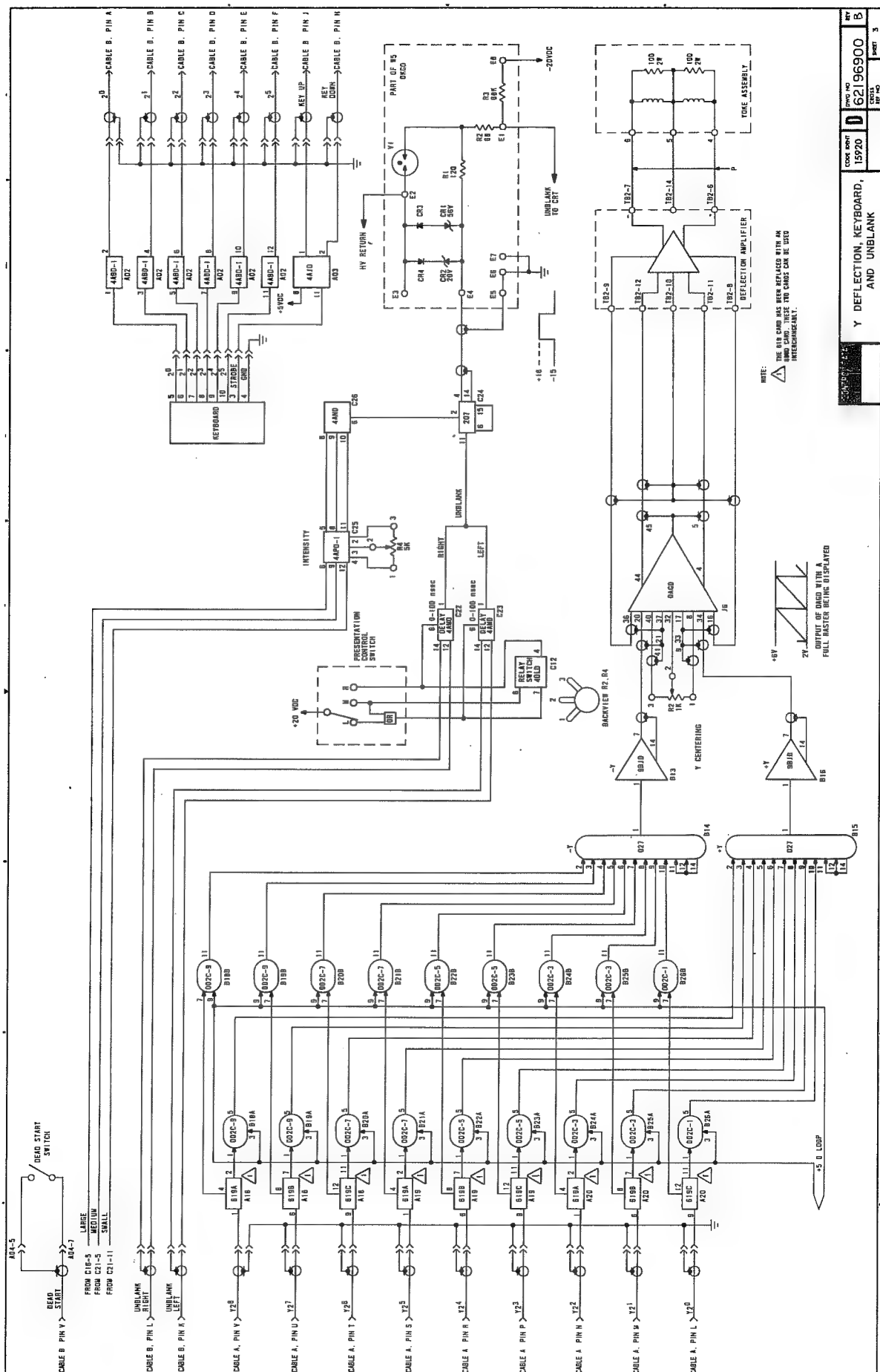
Y DEFLECTION, KEYBOARD, AND UNBLANK

The d/a conversion and deflection circuitry shown here for Y operates the same as X deflection.

The unblank signal is input to its associated unblank receiver (4AMD) card. The 4AMD card has an adjustable delay line to enable alignment between the unblank pulse stream and the analog symbol deflection signals. The 4AMD also provides level shifting to interface with the unblank amplifier (207) card. The symbol size data, via the 122RS cards, is input to the symbol intensity modulation (4APD-1) card. The 4APD-1 card modulates the symbol intensity level according to the size selected. An overall intensity adjustment and individual symbol size intensity adjustments are enabled by potentiometers located on the 4APD-1 card. The 4APD-1 card outputs to the symbol intensity amplifier (4AIND) card. The 4AIND card amplifies the size-modulated intensity signal supplied by the 4APD-1 card and applies this amplified signal to the 207 unblank amplifier card. The 207 unblank timing/shaping card enables a timed unblank pulse varying from -15 volts to +18 volts to the crt control grid via the UKGD (arc-over protect circuit); unblank the crt to paint the symbol.

The presentation switch located on the keyboard enables the operator to either choose one of two separate, nonrelated data streams output by the computer or, in maintenance mode, to show both the left and right presentations simultaneously at a reduced size. The analog and unblank information for both the right and left screen is presented to the console in an alternating fashion. When in either right or left mode, the unblank for that screen only is enabled and the console waits and does nothing while the opposite screen information is present. When the presentation switch is placed in the maintenance (center) position, causing both pages to be displayed, the five relay coils in 4DLD and the single relays on the two 4DND are energized by +20 volts. The relays are connected in series in a manner which puts only 5 volts across each coil. The energized relays cause the following events to happen.

- 1) A tenth term, screen select, is added to pin 11 of the X deflection summing amplifiers. This added term causes the -X current summing amplifier to be more negative for right screen mode and the +X current summing amplifier to be more negative for left screen mode. This results in shifting the right data about 3 inches to the right, and the left data 3 inches to the left.
 - 2) Activating the relay on the 4DND introduces a parallel resistor into the feedback loop increasing the feedback current thus reducing the gain by 25 percent. The display size of the individual left and right screens is reduced from 8 by 8 inches to 8 inches high by 6 inches wide. The right and left presentations are now side by side in an 8 by 12 inch area.
 - 3) Since the gross deflection in the X direction is reduced by 25 percent, the same must be done for the symbols so they will not overlap. This is accomplished by a feedback circuit in the 5AHD-0 card activated by relays on the 4DLD. The result is a 25 percent reduction in the X symbol deflection.
- The 4ABD-1 keyboard interface card interfaces the keyboard-coded outputs (6-bit actual) to the CYBER controller's XI module and isolates the XI module from the 4AJD card. The 4AJD card, by means of a Schmitt trigger circuit, suppresses key bounce. The 4AJD card develops the Key Down/Key Up signals to indicate keyboard key activation. The 4AJD card also has an oscillator which enables the continuous repetitive transmission of a keyboard character if the key is held down for a period of 1 to 3 seconds (adjustable) and which alternately toggles the Key Down/Key Up signals during the repeat operation.



DEFLECTION AMPLIFIER

The deflection amplifier provides current amplification of symbol and positioning inputs and applies this information to symbol and positioning yokes, respectively. There are four identical position amplifiers and four identical symbol amplifiers. Because X and Y positioning and symbol sections are identical, only the X amplifier sections will be explained.

The \pm X-position amplifiers receive push-pull outputs from the X-position feedback amplifier (0AGD). Typical input voltage at pins 11 and 12 ranges from 2 to +6 volts around a +4-volt dc level. A change in voltage at pin 11 is accompanied by an equal voltage change of opposite polarity on pin 12. Each input emitter-follower provides input isolation and current gain to drive the four parallel emitter-followers comprising a position amplifier output stage. Parallel emitter-followers provide the necessary current-handling capability for yoke current. The +X and -X position yokes connect between pins 14 (+40 volts) and 6 and pins 14 and 7, respectively. Back-to-back zener diodes CR1/CR2 and CR3/CR4 parallel the -X and +X position yokes.

Refer to the following simplified illustration of yoke and amplifier interconnection. The zeners prevent breakdown of output transistors caused by inductive voltage spikes and enable faster deflection by decreasing yoke switching time.

As amplifier input voltage becomes more positive, yoke current increases and vice versa. The approximate +X and -X position input voltages to the 0ADG card and corresponding crt beam position for normal mode are:

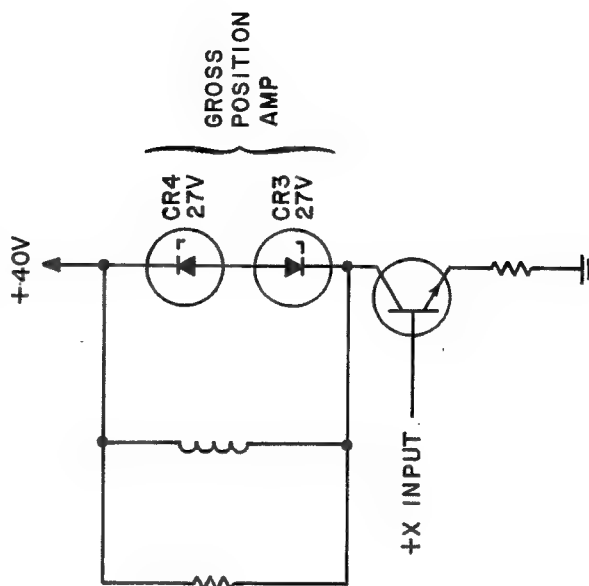
+X Input	-X Input	Beam Position
+6 volts	+2 volts	Left
+4 volts	+4 volts	Center
+2 volts	+6 volts	Right

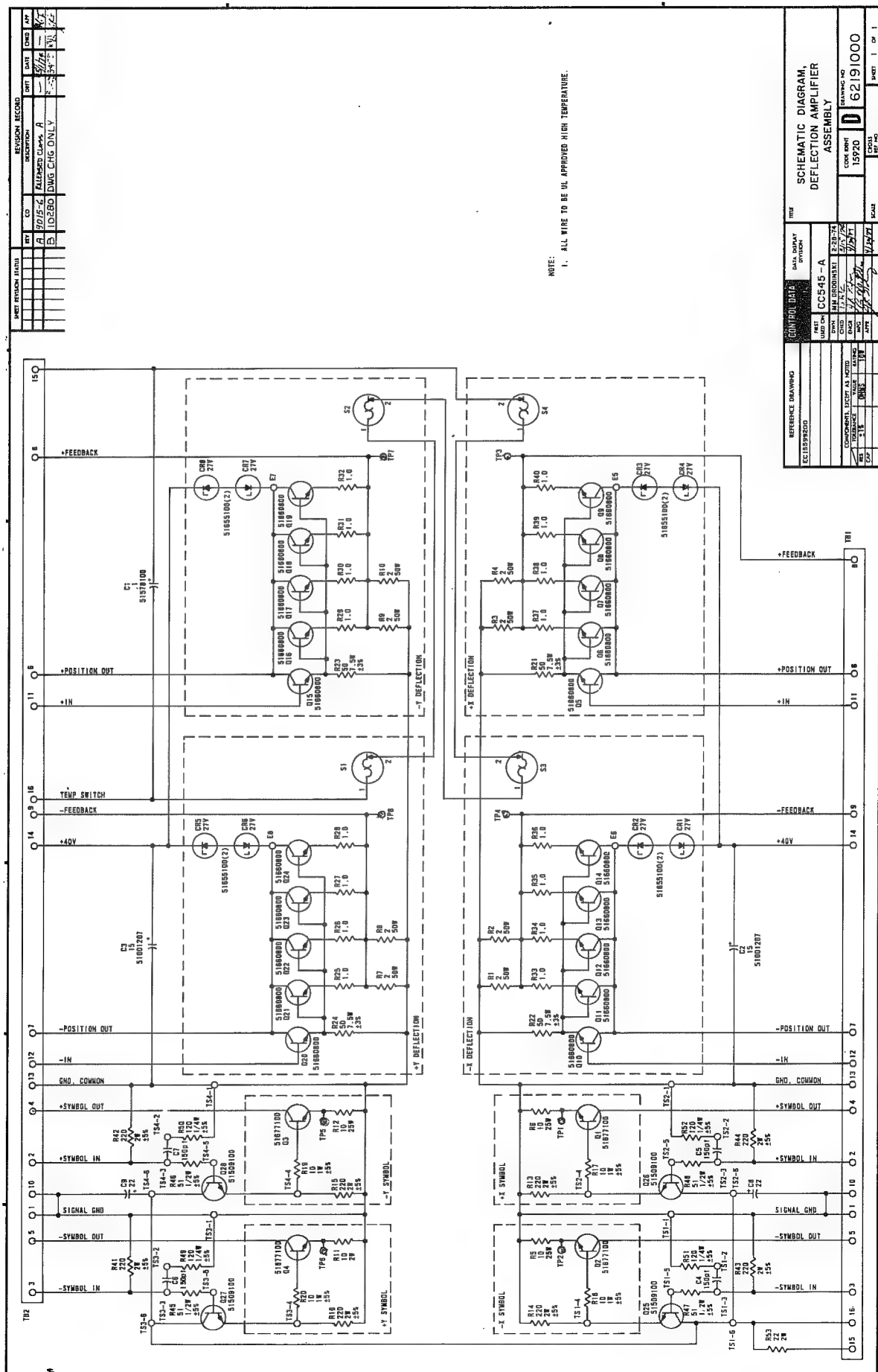
A negative feedback voltage developed across amplifier emitter resistors reflects changes in deflection current. Negative feedback stabilizes and improves the frequency response of the feedback and deflection amplifier loop.

The symbol amplifier sections operate on the same principle as the position amplifiers. Current for symbol deflection is much lower because of the smaller beam movements required. Typical +X symbol input voltages and corresponding beam positions within the symbol matrix are:

+X Symbol Input	-X Symbol Input	Matrix Position
+8 volts	+4 volts	Left
+6 volts	+6 volts	Center
+4 volts	+8 volts	Right

The four thermostats (S1 through S4) provide high-temperature protection. Should the internal temperature rise to 190°F or greater in any one of the sections, the associated thermostat opens and the high-voltage supply turns off immediately. After 15 seconds, the deflection/crt supply turns off. When the temperature drops to 170°F or below, the thermostats close and power comes back on in the reverse sequence.





DEFLECTION AMPLIFIER

The deflection amplifier provides current amplification of symbol and positioning inputs and applies this information to symbol and positioning yokes, respectively. There are four identical position amplifiers and four identical symbol amplifiers. Because X and Y positioning and symbol sections are identical, only the X amplifier sections will be explained.

The $\pm X$ -position amplifiers receive push-pull outputs from the X-position feedback amplifier (OAGD). Typical input voltage at pins 11 and 12 ranges from 2 to +6 volts around a +4-volt dc level. A change in voltage at pin 11 is accompanied by an equal voltage change of opposite polarity on pin 12. Each input emitter-follower provides input isolation and current gain to drive the four parallel emitter-followers comprising a position amplifier output stage. Parallel emitter-followers provide the necessary current-handling capability for yoke current. The +X and -X position yokes connect between pins 14 (+40 volts) and 6 and pins 14 and 7, respectively. The 30-V zener diodes and the diode bridge parallel the -X and +X position yokes. They prevent breakdown of output transistors caused by inductive voltage spikes and enable faster deflection by decreasing yoke switching time. Refer to the diagram below for a simplified illustration of the yoke and amplifier interconnection.

As amplifier input voltage becomes more positive, yoke current increases and vice versa. The approximate +X and -X position input voltages to the OAGD card and corresponding crt beam position for normal mode are:

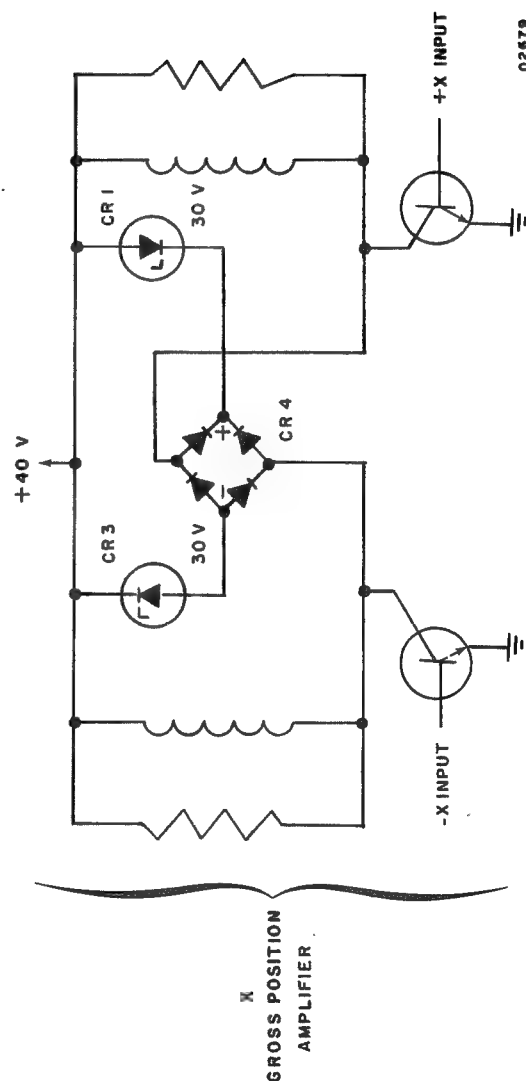
+X Input	-X Input	Beam Position
+6 volts	+2 volts	Left
+4 volts	+4 volts	Center
+2 volts	+6 volts	Right

A negative feedback voltage across amplifier emitter resistors reflects changes in deflection current. Negative feedback stabilizes and improves the frequency response of the feedback and deflection amplifier loop.

The symbol amplifier sections operate on the same principle as the position amplifiers. Current for symbol deflection is much lower because of the smaller beam movements required. Typical +X symbol input voltages and corresponding beam positions within the symbol matrix are:

+X Symbol Input	-X Symbol Input	Matrix Position
+8 volts	+4 volts	Left
+6 volts	+6 volts	Center
+4 volts	+8 volts	Right

The four thermostats (S1 through S4) provide high-temperature protection. Should the internal temperature rise to 190°F or greater in any one of the sections, the associated thermostat opens and the high-voltage supply turns off immediately. After 15 seconds, the deflection/crt supply turns off. When the temperature drops to 170°F or below, the thermostats close and power comes back on in the reverse sequence.



02579

POWER CONTROL PANEL

The power control panel contains maintenance controls and indicators which enable on/off and thermal condition control and indication. On display stations when used, a running time meter shows the on time of the station. The power control panel receives power from 60-Hz or 50-Hz and 400-Hz sources and routes it to the ± 20 -volt supply, the deflection/crt supply, and blowers. It also routes power from the ± 20 -volt power supply to the deflection/crt supply and to the deflection amplifier high-temperature switches. Power off and high-temperature thermal delays provide 15 seconds between dropping of high voltage to the crt and turn-off of all power or deflection/crt supply input power, respectively.

Assuming CB1 and CB2 are both closed, depressing POWER ON (momentary switch) applies 60-Hz line voltage to power on relay K6. This applies voltage to the blowers, the running time meter M1, the contacts of relay K2, the contacts of relay K3, and the coil of relay K4. Contacts of K2 provide the hold path for K6. Immediately after turn on, K4 pulls and applies 400-Hz power to the ± 20 -volt power supplies. Relay K5 energizes and applies 400-Hz, 3-phase power to the deflection/crt power supply. Providing a high-temperature condition does not exist in the deflection amplifier, -20 volts through the high-temperature thermostats pulls K7. K7-8 applies $+20$ volts to the deflection/crt supply which in turn applies it to the high-voltage supply and lights the READY indicator after a 15-second delay.

When a high-temperature thermostat in the deflection amplifier opens, -20 volts to K7 are removed and K7 drops out. Dropping K7 removes $+20$ volts from the high-voltage supply, turns on the HIGH TEMP indicator, and applies line voltage to the filament of thermal relay K3. After 15 seconds, the contacts of relay K3 open and drop relay K5. Dropping K5 removes input power to the deflection/crt supply. Pressing the THERMOSTAT BY-PASS switch energizes K7 and restores removed voltages.

POWER OFF pulls power off relay K1. Contact 6 provides the hold path for K1 while contact 4 removes $+20$ volts from the high-voltage supply. After approximately 15 seconds, thermal relay K2 opens. Opening the contacts of K2 drops power on relay K6, removing all power.

DEFLECTION/CRT POWER SUPPLY

The deflection/crt power supply provides the following outputs:

DC Voltage	Destination
+6.3	CRT filament
+20	High-voltage supply
+40	X position yoke
+40	Y position yoke
+15 to +110	CRT cathode
+420	CRT grid 2
+700	Focus potentiometer

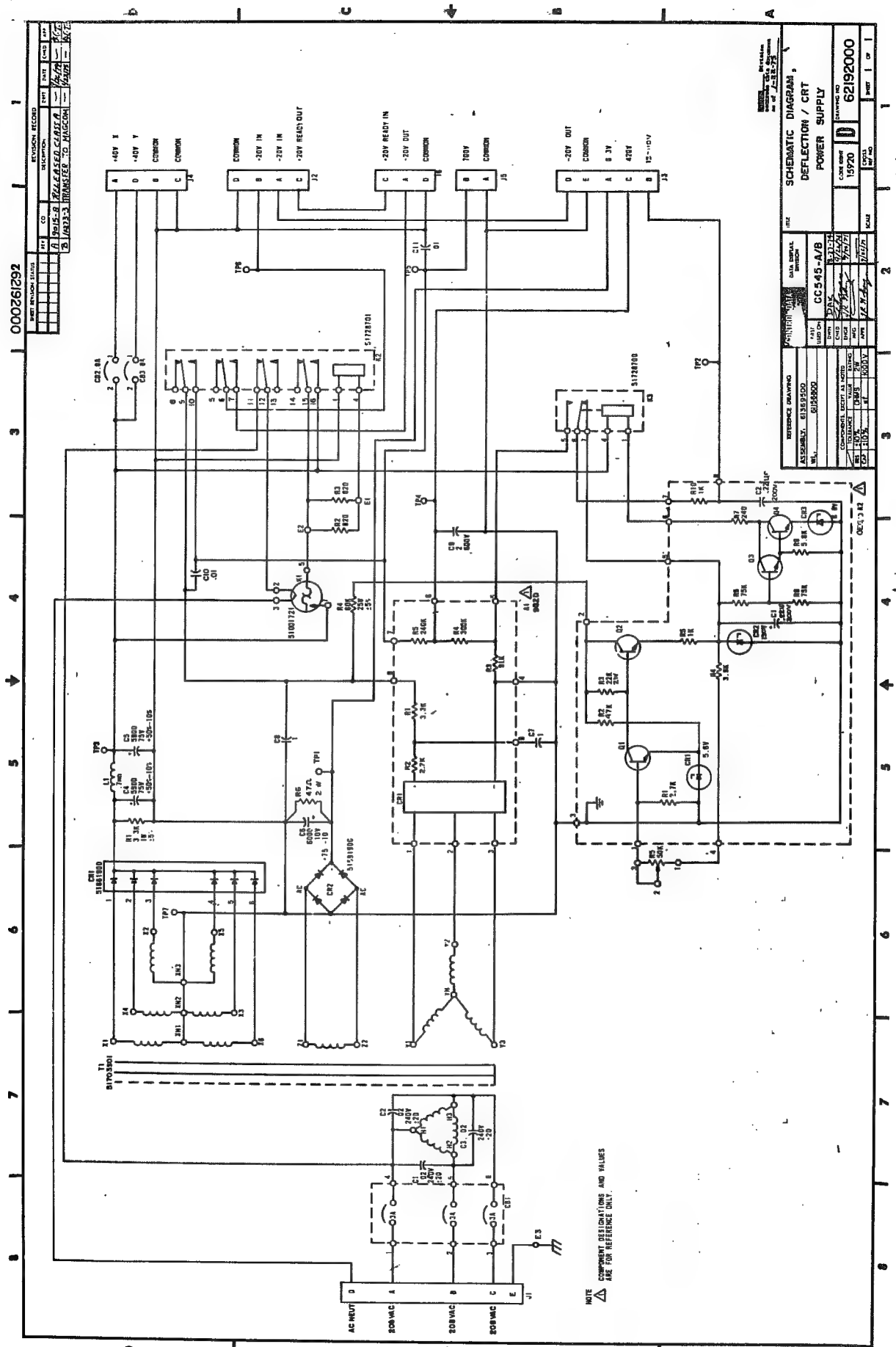
Circuit breaker CB1 applies 400-Hz power from the power control panel. All voltage outputs except the +700-volt focus potential, +420-volt grid 2 potential, and +20 volts for the high-voltage power supply are available immediately after power on. Thermal relay K1 and relay K2 delay the +20, and +420, and +700-volt outputs for 15 seconds, providing crt protection during power turn on. When power comes on, normally-closed contact 11 of K2 applies one phase of the 400-Hz Input to thermal relay K1. Closing of K1 after 15 seconds energizes K2. Normally-open contact 16 latches K2 and opening of normally-closed contact 11 releases K1. Closing of K2-7 supplies +20 volts to the high-voltage supply. Contact K2-10 applies +700 volts to the output and to the voltage divider providing the +420-volt output.

The source of the +700 volts in the 3-phase, full-wave, bridge rectifier CR1 (98ZD card, assembly A1) and its associated input transformer.

The 0EQD card (assembly A2) together with potentiometer R5 form a regulated supply with a +15- to +110-volt output. R5 provides the regulation feedback path and establishes the output voltage by varying the bias for Q1. Zener diode CR2 protects Q1 and Q2 from crt high-voltage arcing. With the +15- to +110-volt output present, Q3 and Q4 conduct and hold relay K3 closed. Loss of this voltage or less than 20 volts releases K3 and normally-closed contact 5 applies +100 volts to the cathode. This prevents burning the crt phosphor. Relay K3 also drops if the +40-volt supply fails.

NOTE

The 0EQD card is applicable to the CC545-C/D while the 0EQD-1 card pertains to the CC545-E/F. The above theory describes the operation of both 0EQD and 0EQD-1 cards.



20-KV POWER SUPPLY

This supply provides a +18-kilovolt output for the crt post accelerator anode from a +20-volt input.

Upon application of +20 volts to T81-2, Q3 and Q5 saturate. This provides collector voltage and base bias for chopper transistors Q1 and Q2 via transformers T1 and T2, respectively. The difference in translator characteristics causes one of the chopper transistors, Q1 or Q2, to begin conducting faster than the other. The change in current through the primary of T2 produces secondary polarities which drive the faster transistor toward saturation and the other transistor toward cutoff. After Q1 and Q2 reach saturation and cut off, the primary field collapses and reverse the states of Q1 and Q2. The chopper continues to oscillate until removal of the +20-volt input. By adjusting current through the primary of T2, feedback potentiometer R1 provides chopper frequency control. Potentiometer R3 balances conduction of Q1 and Q2. With the chopper oscillating, center-tapped high-voltage transformer T1 produces a square wave output. The 2000-turn secondary winding supplies a high-voltage square wave to the voltage quadrupler. The output of the quadrupler feeds the post accelerator anode of the crt. The 3-turn secondary winding samples the high-voltage output. CR1 and C1 half-wave rectify the sample voltage. This rectified sample voltage, positive dc level, controls conduction of differential amplifier Q1/Q2. Q4 then regulates the center tap current of T1 by controlling conduction of power amplifiers Q3 and Q5. This sample loop stabilizes the high-voltage output at the voltage established by the setting of output voltage adjustment potentiometer R2. Clockwise rotation of R2 increases the high-voltage output and vice versa. Prior to adjusting the output, chopper feedback and balance potentiometers must be adjusted for the approximate waveform shown on the diagram.

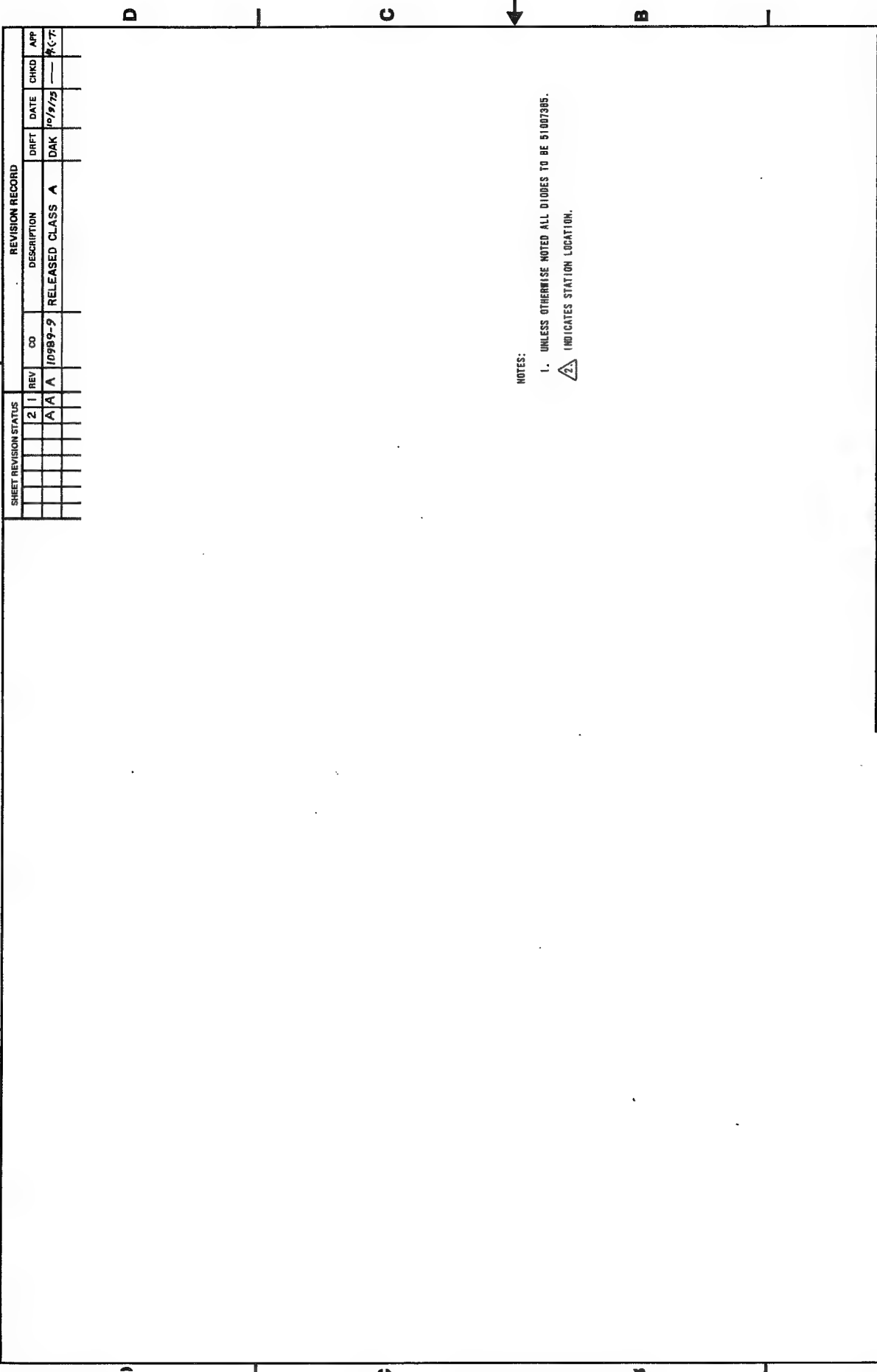


KEYBOARD SWITCHES AND DIODE ENCODER

The alphanumeric keyboard contains 50 magnetic dry-reed switches and a diode encoder. Each of the switches connects to a group of diodes. Pressing a switch applies ground to its associated diodes. Encoder output pins 5 through 10 apply the key code to the keyboard and computer interface cards in the d/a chassis. The output pins are normally open, transmitting 0's to the computer. Pressing a key applies ground to selected outputs, transmitting 1's to the computer. Diode encoder input pin numbers correspond to the code for the associated key.

The strobe OR gate feeding pin 3 is not used. Pin 3 goes to ground with each key depression and is available for future expansion of keyboard capability if required.

1 2 3 4

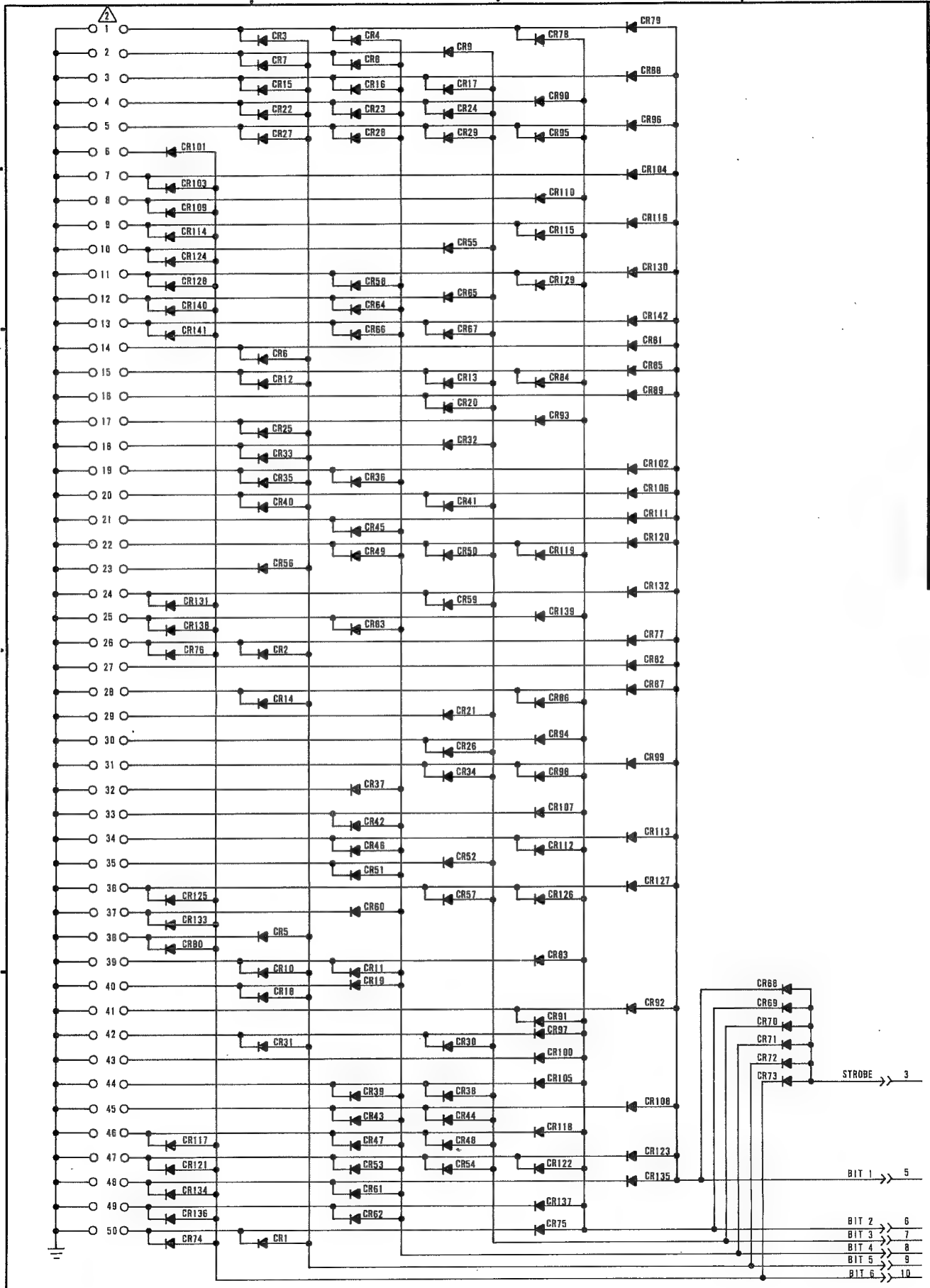


NOTES:
1. UNLESS OTHERWISE NOTED ALL DIODES TO BE 51007385.
2. INDICATES STATION LOCATION.

62952600 L

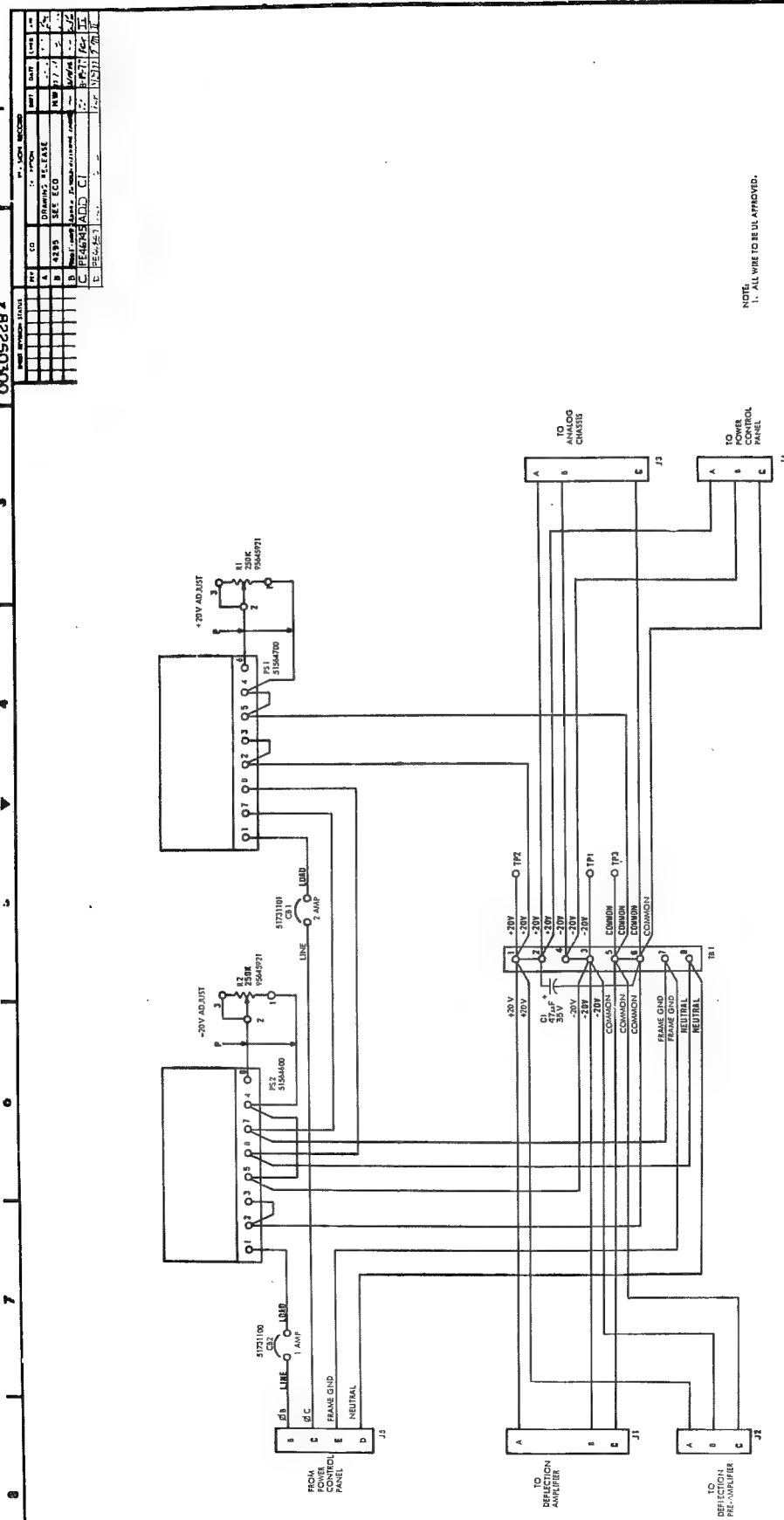
5-22.1/5-22.2

REFERENCE DRAWING		TITLE	
ASSEMBLY 90427300		SCHEMATIC DIAGRAM	
DETAIL 90427200		5AXD-O	
		(50 KEY DIODE MATRIX)	
COMPONENTS, EXCEPT AS NOTED		DRAWING NO	
RES TOLERANCE	VALUE RATING	C 90427100	
CAP			
FIRST USED ON		CODE IDENT	CROSS REF NO
DWN		15920	SCALE
CHKD		SHEET 1 OF 2	
ENGR			
APR			
CC545-A-B			
D A K			
7-11-75			
8-1-75			
7-28-75			
9-4-75			
7-7-75			



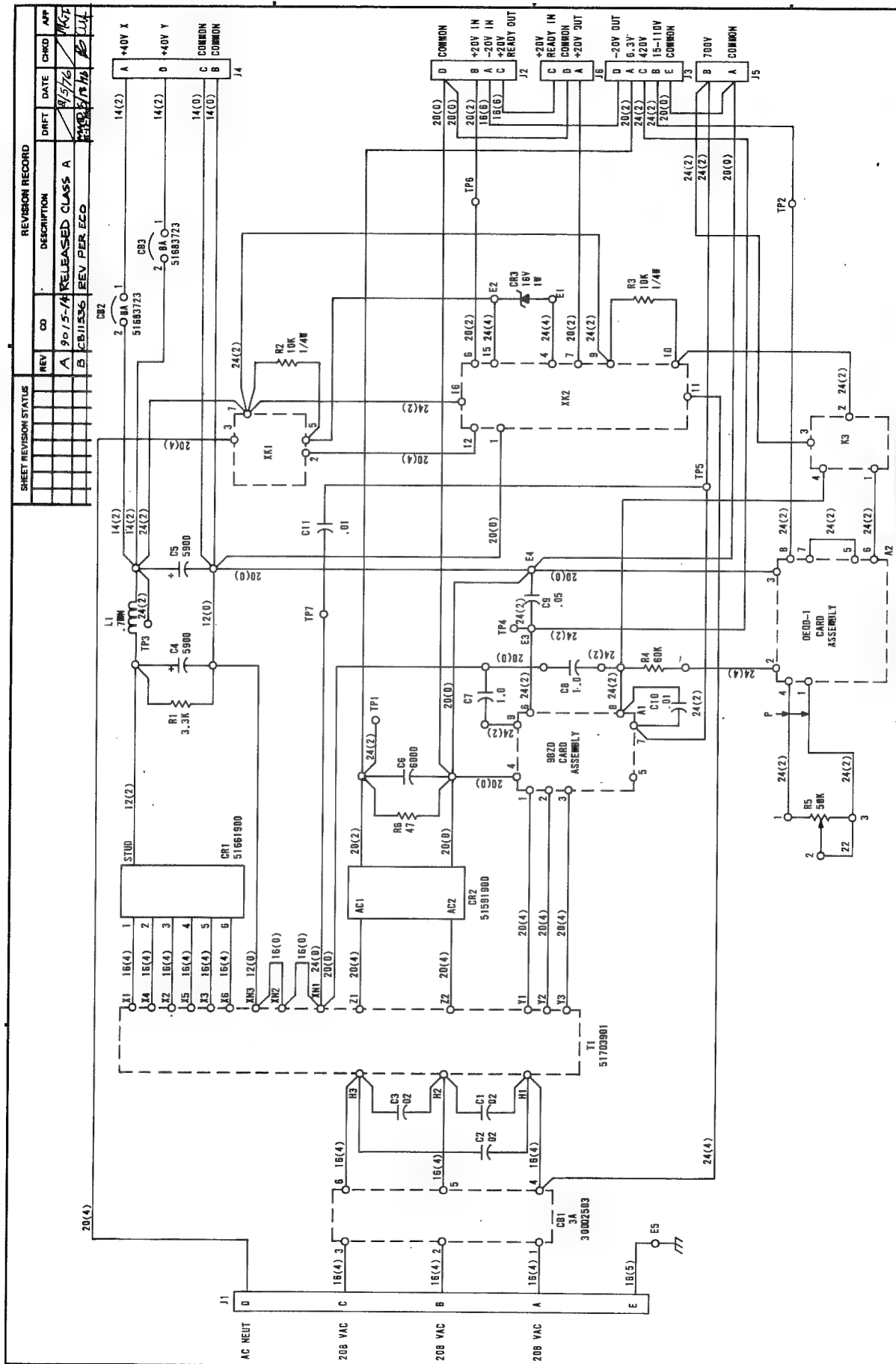
+20V AND -20V POWER SUPPLY

This assembly has two separate supplies, PS1 and PS2. Each supply has its own circuit breaker for control of the 400-Hz, single-phase input. External potentiometers provide adjustment. The supplies are not field repairable and must be replaced upon failure.



NOTE:
1. ALL WINE TO BE UL APPROVED.

[illegible][illegible]



REVISION RECORD			
REV	CD	DESCRIPTION	DATE
A	9015-14	RELEASED CLASS A	9/5/76
B	CBJ1536	REV PER ECO	2/28/77
C			
D			
E			

REFERENCE DRAWING			
ASSEMBLY	W.L.	DATE	BY
61407414	61407413	2/25/76	W.L.

INTERCONNECTION DIAGRAM DEFLECTION/CRT POWER SUPPLY			
CODE	DATE	REV	NO
15920	2-17-75	1	62200800

COMPONENTS, EXCEPT AS NOTED			
VALUE	TOLERANCE	DATE	BY
15920	2-17-75	2-17-75	W.L.

NOTES:			
1. COMPONENT DESIGNATIONS AND VALUES ARE FOR REFERENCE ONLY.			
2. WIRE GAUGE AND COLOR ARE FOR REFERENCE ONLY.			

THERE IS NO SCHEMATIC
DIAGRAM AVAILABLE FOR THE
18-KILOVOLT HIGH-VOLTAGE POWER SUPPLY
PART NUMBER 51918275

SECTION 6

MAINTENANCE

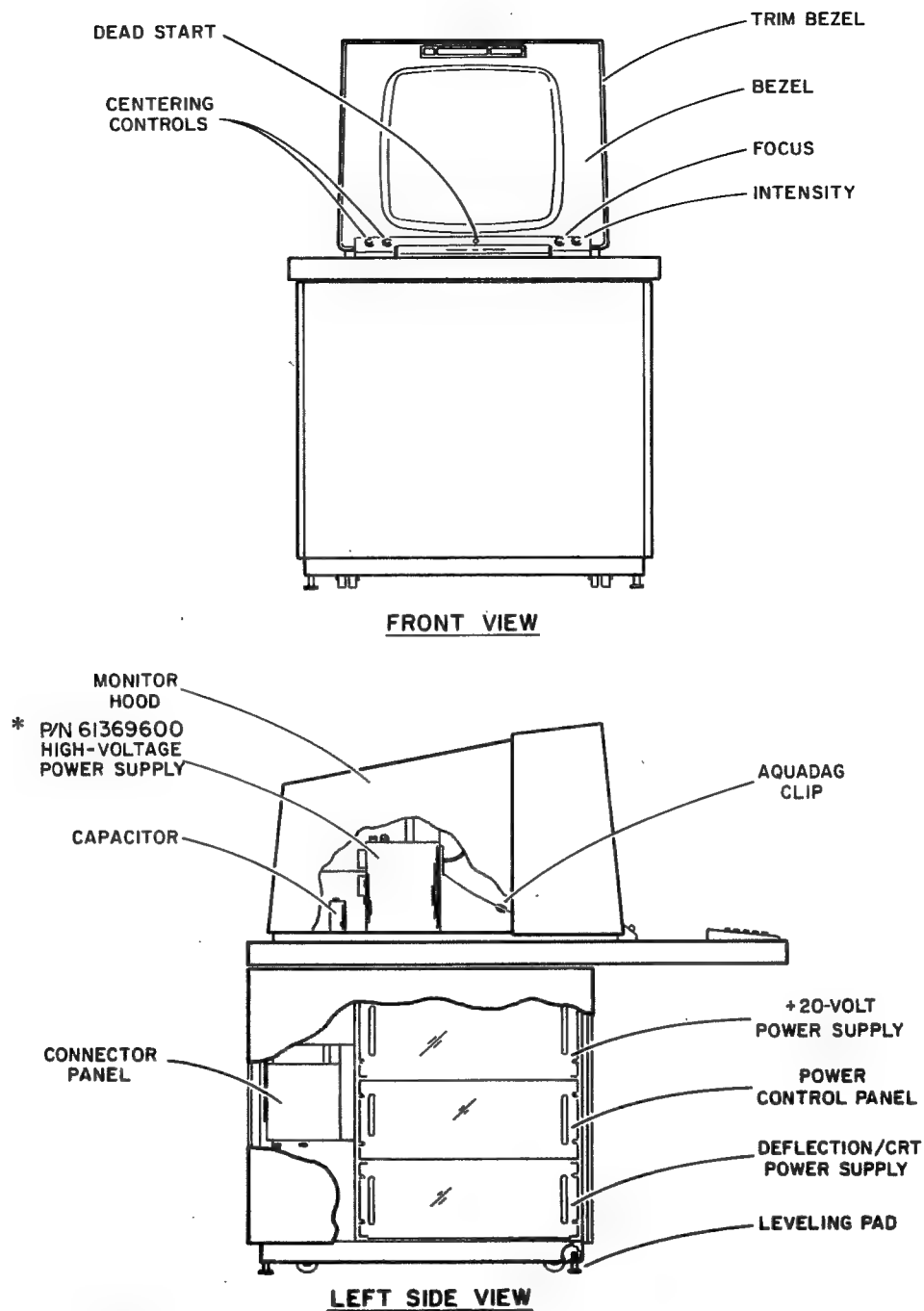
Information in this section enables effective on-site maintenance of the station. Certain adjustments require viewing the display. This necessitates two maintenance personnel for making adjustments quickly and accurately. Contents of this section include: station layout, test equipment, preventive maintenance, troubleshooting aids, high-voltage power supply maintenance, deflection amplifier maintenance, display adjustment, power supply adjustment, and remove/replace procedures.

WARNING

The station contains lethal voltages and only trained personnel should perform maintenance.

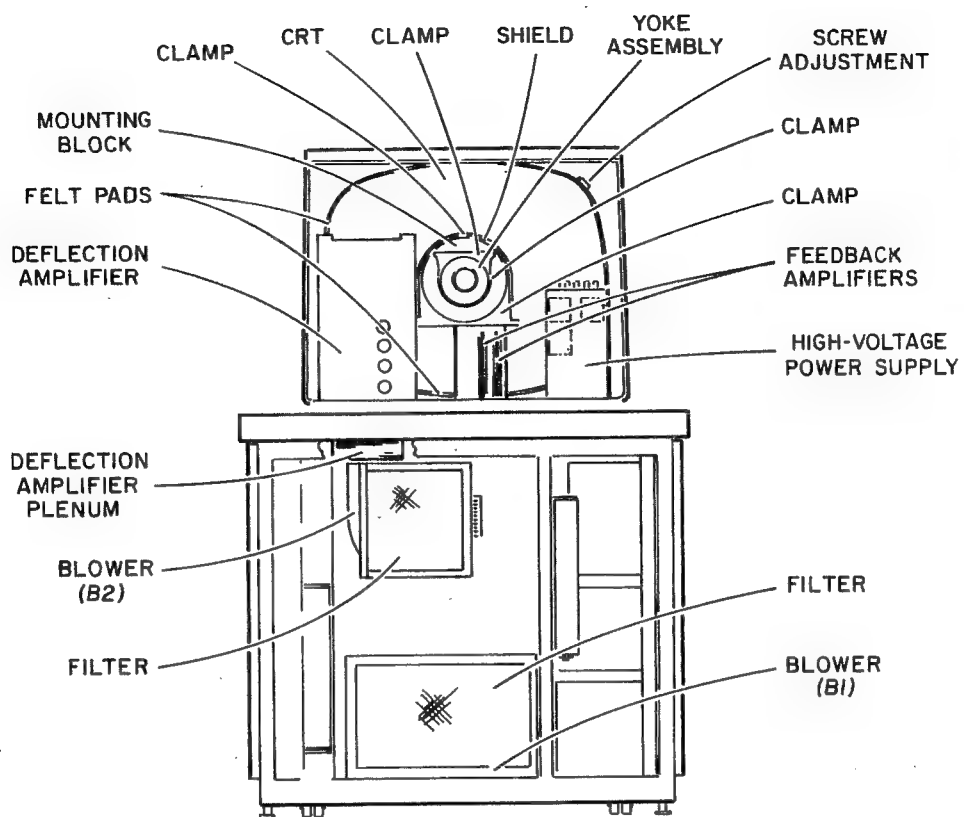
STATION LAYOUT

Maintenance requires familiarity with the physical location of the assemblies and subassemblies. Figures 6-1 and 6-2 show the major assemblies/subassemblies.

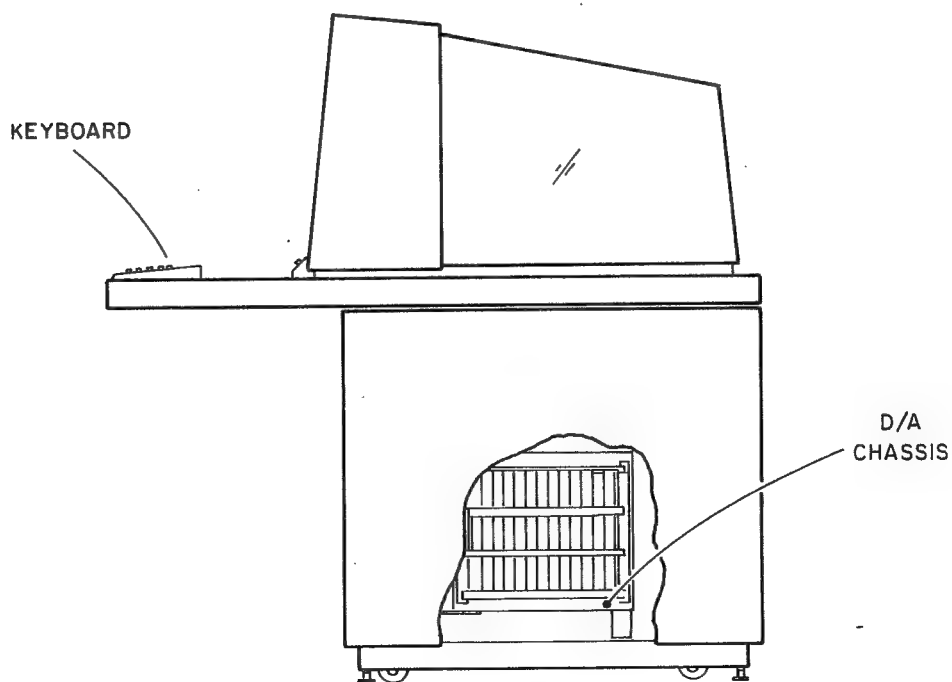


* 01308-1
 * REPLACEMENT POWER SUPPLY, P/N 51918275 NOT SHOWN,
 BUT IT IS INSTALLED IN SAME LOCATION AS P/N 61369600 POWER SUPPLY.

Figure 6-1. Console Front and Left Side Assembly Views



REAR VIEW



RIGHT SIDE VIEW

01309

Figure 6-2. Console Rear and Right Side Assembly Views.

TEST EQUIPMENT

Table 6-1 lists all test equipment recommended for proper maintenance.

TABLE 6-1. RECOMMENDED TEST EQUIPMENT

QUANTITY	ITEM	DESCRIPTION	MANUFACTURER'S PART NO.	CDC PART NO.
1	Oscilloscope	Tektronix, Type 546 or equivalent		
1	Dual-Trace Plug-in Unit	Tektronix, Type 1A1 or equivalent		
1	1X Probe	Tektronix, Type P6027 or equivalent	010-0071-00	
2	10X Probe	Tektronix, Type P6010 or equivalent	010-0185-00	
2*	12-inch Ground Lead	Tektronix	175-0125-00	
2*	Spring Tip	Tektronix	206-0060-00	
2*	Hook Tip	Tektronix	206-0105-00	12210992
2*	Minigator Clips	Tektronix	344-0046-00	
1	Photometer	Gamma Scientific, Model 2020		
1	Multimeter	Simpson 269, Series 2 or equivalent		
1	High-Voltage Probe	Simpson No. 0157, 40 kv or equivalent		
2	Board Extender	Control Data, 50-pin		44948200-A
2	Card Extender	Control Data, 15-pin		51006005
* This equipment is part of the probe set but can be purchased separately.				

PREVENTIVE MAINTENANCE

Preventive maintenance is scheduled maintenance designed to prevent failures rather than correct malfunctions. It is meant to keep equipment in top operating order and cut down the chances of failure during production runs. Table 6-2 is the preventive maintenance schedule.

At each installation a site log should be kept in which to record equipment maintenance. This is particularly useful to expose electrical deterioration. A record of voltage readings taken when the equipment is operating normally is a valuable maintenance aid if the equipment deteriorates. Records of this nature should also list the test equipment used for the measurement, i.e., manufacturer and model number.

Preventive maintenance information appears in tabular form beginning with an overall preventive maintenance schedule and continuing with tables for each scheduled maintenance period. The preventive maintenance tables 6-3 through 6-5 are arranged in a check and action sequence. If a check condition is not fulfilled, the action column specifies corrective procedures.

TABLE 6-2. PREVENTIVE MAINTENANCE SCHEDULE

INTERVAL	TIME REQUIRED (Approx Hours)	MAINTENANCE
Weekly	0.3	Exterior cleaning
	0.2	Visual inspection
	0.2	Diagnostic check
Monthly	0.5	Interior cleaning and inspection
	0.5	Electrical measurements and adjustments
Quarterly	0.5	Clean air filters
	0.1	Check blowers
	0.5	Time delay and high-temperature checks

TABLE 6-3. WEEKLY CLEANING AND INSPECTION

CHECK CONDITION	ACTION
Station power off.	<p>Remove scuff marks from the exterior with mild detergent (used moderately) and wiping cloth. Do not use detergent on the crt face or near the switches.</p> <p>Brush dust from angular areas using a paint brush.</p> <p>Clean the crt face with liquid lens cleaner and a soft, lint-free cloth or a wet newspaper and dry paper towel.</p> <p>Remove the monitor cover and visually inspect the monitor interior for obvious faults (eg; scorched components, signs of arcing, loose assemblies, etc.). Repair as necessary and replace the cover.</p>
Station power on.	<p>Verify operation of the running time meter.</p> <p>Verify proper mechanical and electrical operation of all switches, indicators and controls.</p> <p>Ensure proper air flow from blowers.</p>
Ensure proper operation of all diagnostic test sections.	<p>Refer to the maintenance procedure for the specific malfunction.</p>

TABLE 6-4. MONTHLY CLEANING, INSPECTION, TESTS, AND MEASUREMENTS

CHECK CONDITION	ACTION
<p>Station power off.</p> <p><u>WARNING</u></p> <p>The station contains lethal voltages. Use extreme caution in all maintenance procedures being followed.</p>	<p>First put on safety glasses! Remove monitor hood and access snap-on panels around base. Clear interior surfaces with a vacuum cleaner (do not damage wiring or components).</p> <p>Visually inspect to ensure that all cabling and wires are free from insulation breakdown.</p> <p>Check on component deterioration and foreign objects such as bits of wire or solder.</p> <p>Replace monitor hood and access panels.</p> <p>Remove keyboard and thoroughly wash all contacts with a recommended foam spray.</p> <p>Reinstall keyboard.</p>
Station power on.	<p>Verify proper mechanical and electrical operation of all switches, indicators, and controls.</p> <p>Make electrical measurements/adjustments for cathode emission, ± 20-volt power supply, high-voltage supply, unblank timing, and symbol/raster size as described later in this section.</p>

TROUBLESHOOTING AIDS

Troubleshooting is done in three basic stages: fault symptom diagnosis, fault locating (pinpointing), and fault correction. The electrical diagrams in Section 5 aid in all three troubleshooting stages. Table 6-6 lists the most common problems and probable causes. Additional information encompasses high-voltage maintenance and pointers on deflection amplifier repair.

TABLE 6-6. FAULT DIAGNOSIS

SYMPTOM	CAUSE
Blowers running but no POWER ON light	<ol style="list-style-type: none"> 1) No 400 Hz 2) No -20 volts 3) Bad indicator lamps
HIGH TEMP light on only	<ol style="list-style-type: none"> 1) No -20 volts
No READY	<ol style="list-style-type: none"> 1) No +20 volts 2) No 400 Hz to deflection/crt power supply 3) Bad indicator lamps 4) High-temperature condition 5) No +40 volts from deflection/crt power supply
POWER ON and READY indicators lit but no picture on either left or right screen presentation	<ol style="list-style-type: none"> 1) No high voltage (chopper did not start). If perfectly balanced, the chopper won't oscillate and there will be no high-voltage power. 2) No unblank (207 or 4AMD card) 3) Crt protect circuit in deflection/crt power supply active (cathode voltage at +100 volts) 4) No crt filament voltage
Unblank all the time	<ol style="list-style-type: none"> 1) Bad 207 or 4AMD card 2) Cathode voltage too low 3) +420 volts to crt grid G2 too high
POWER ON and READY indicators lit and picture on right screen but no picture on left screen presentation	<ol style="list-style-type: none"> 1) Bad 4AMD in position C23
POWER ON and READY indicators illuminated and picture on left screen but no picture on right screen presentation	<ol style="list-style-type: none"> 1) Bad 4AMD in position C22
Unblank all the time on one screen but normal on the other screen presentation	<ol style="list-style-type: none"> 1) Check 4AMD in appropriate position (C23 or C22)
Excessive picture noise	<ol style="list-style-type: none"> 1) Improper high-voltage power supply chopper waveform 2) Power and logic cables intertwined 3) Power cables not shielded (see site requirements Section 3)

TABLE 6-6. FAULT DIAGNOSIS (CONT)

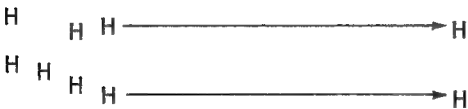
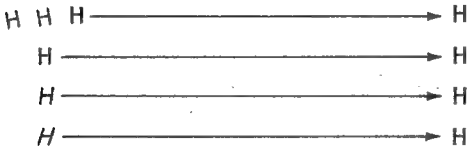
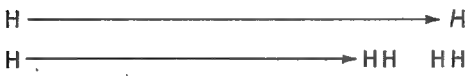
SYMPTOM	CAUSE
No deflection/crt power supply outputs	1) No -20 volts 2) No 400 Hz
+40-volt circuit breaker on deflection/crt power supply not holding	1) Defective zener diode or transistor in the deflection amplifier 2) Feedback amplifier (0AGD card) level grossly misadjusted
Following condition in upper left corner of the display raster when retracing from the lower right corner:	
	1) Improper 0AGD card level adjustment 2) Program not allowing sufficient settling time
Following indications at left of display raster:	
	1) Improper 0ADG level 2) Insufficient programmed settling time
Following indications at right of display raster:	
	1) Insufficient program or controller settling time 2) Improper 0AGD level
Improper key code(s) being transmitted	1) Bad diode on keyboard diode matrix 2) Bad keyswitch 3) Bad 4ABD-1 keyboard interface card 4) No +5 volts to 4AJD card 5) Bad 4AJD keyboard debounce and repeat oscillator
No repeat feature when keyboard key pressed for more than 1 to 3 seconds (adjustable)	1) No +5 volts to 4AJD card 2) Bad 4AJD card
No horizontal symbol deflection	1) Bad 5AHD-0 in location C05 2) Bad 620 in location C02
No vertical symbol deflection	1) Bad 4ALD in location C07 2) Bad 620 in location C10
No maintenance mode	1) No power to relay card pins 6 and 12 4DLD in location C12. 2) Bad presentation switch

TABLE 6-6. FAULT DIAGNOSIS (CONT)

SYMPTOM	CAUSE
Both presentations drawn on top of each other when maintenance mode selected	<ol style="list-style-type: none"> 1) No screen select (X2⁹) signal on cable B, pin W 2) Bad 619 card location A07 3) Bad 002C-3 card location B02 4) Bad relay on 4DLD card in location C12
Presentation size not reduced to 5.75 inches each when maintenance mode selected	<ol style="list-style-type: none"> 1) No power to relay on 4DND cards (pin 8) in location A13 or A16. 2) Bad relay on 4DND card in location A13 or A16.
Only one presentation unblanked when maintenance mode selected	<ol style="list-style-type: none"> 1) Bad relay on 4DLD card in location C12.
Horizontal symbol sizes not reduced by approximately 25% when maintenance mode selected	<ol style="list-style-type: none"> 1) Bad relay or relays on 4DLD card in location C12.

REPAIR LEVELS

The repair level will consist of replacing the entire assembly in some cases, or repair down to the component level.

HIGH-VOLTAGE POWER SUPPLY — PART NUMBER 61369600

The quadrupler is not field repairable. Repair will be accomplished by the replacement of the quadrupler, the 9BCD PC card, or transistors Q1 through Q5.

HIGH-VOLTAGE POWER SUPPLY — PART NUMBER 51918275

The repair level will consist of replacing the entire assembly.

POWER CONTROL PANEL

The repair level will consist of replacement down to the component level.

±20-VOLT POWER SUPPLY

Repair will be accomplished by the replacement of the PC cards, transistors, or semiconductors if the problem can be quickly isolated. If the problem is not easily identified, or if the transformers need replacement, the entire power supply should be replaced.

DEFLECTION/CRT POWER SUPPLY

The repair level will consist of replacement down to the component level. The 9BZD, 0EQD and 0EQD-1 cards may be replaced. The transformer, T1, is an exception. If the transformer is found to be faulty, replace the entire assembly.

KEYBOARD

Repair will consist of the replacement of faulty switches and/or diodes. In the event that a large number of keys are faulty, replace the entire assembly.

DEFLECTION AMPLIFIER

Repair will consist of replacement of transistors Q1 through Q24 or zener diodes CR1 through CR8. If the deflection amplifier is at fault and problems persist, replace the entire assembly.

Mylar tape (P/N 95670603) should be placed on the underside of the deflection amplifier coverplate. This will prevent the coverplate from shorting to a 40-V contact on the heat sink. Placement of the tape stripes is as shown in figure 6-2.1, 1.56 inches from each side of the coverplate edge.

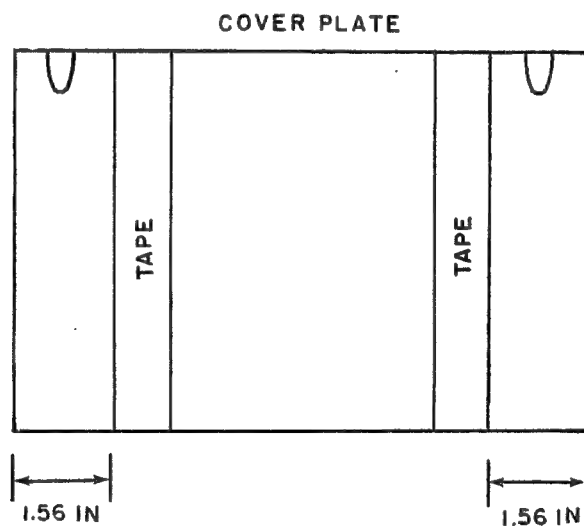


Figure 6-2.1. Tape Stripe Location

HIGH-VOLTAGE POWER SUPPLY MAINTENANCE

The high-voltage power supply requires special maintenance techniques because of the voltage involved. The following paragraphs describe high-voltage characteristics, metering material that is applicable to both types of power supply described here, and the repair techniques for the part number 61369600 power supply.

CORONA

Corona is a discharge of electricity, due to ionization of the air around the surface of a high-voltage conductor. It is frequently luminous and tends to load an affected circuit. It is undesirable in the high-voltage power supply because it causes either intermittent or constant circuit imbalance. Normally, elimination of two conditions prevents corona. The first condition is poor finishing of solder connections. The second is high room humidity.

Corona varies directly with humidity but does not become a problem until relative humidity exceeds 70 percent. This is the specified environmental limit and is mentioned to give awareness of the importance of environment. Relative humidity may vary and it should be checked at the first sign of display deterioration.

METERING THE SUPPLY

When metering the power supply there are two primary considerations: the tolerance of the test equipment and the extra circuit load presented by some test equipment. Tolerance of the test equipment is the scale accuracy specified by the test equipment manufacturer. The extra circuit load presented by some test equipment loads down the circuit being measured causing erroneous readings. The multimeter and high-voltage probe listed in the table of recommended test equipment provides the desired accuracy and loading.

LOCATING HIGH-VOLTAGE ARCS AND CORONA

This information is applicable only to the 61369600 supply. High-voltage arcing can cause failure of differential amplifier transistors Q1 and Q2 on the 9BCD card within the high-voltage assembly. Locate high-voltage arcs by opening the high-voltage assembly, turn off or lower room lighting, and watch for arcing after turning power on. Since arcing is usually visible and/or audible, this technique often locates the arc and saves time-consuming work with a meter or oscilloscope.

Corona may be located using the same technique.

DISCHARGING (BLEEDING) HIGH-VOLTAGE CIRCUITS

NOTE

This is a field service related topic for part number 61369600 power supply. The part number 51918275 power supply is not to be serviced because it requires replacement upon failure.

The high-voltage supply operates at a lethal potential. Capacitors in this circuit and the crt can retain a charge long after the equipment is turned off. This is especially true if the normal circuit discharge path has a faulty component such as an open resistor.

Before touching high-voltage circuitry inside power supply, use a correctly rated multimeter and probe to verify the absence of high voltage. If residual high voltage is found, hold the probe on the voltage point and the multimeter will provide a safe discharge path and also will indicate when the circuit is safe.

DEFLECTION AMPLIFIER MAINTENANCE

When replacing deflection amplifier transistors or zener diodes, coat the base and both sides of the insulator disks with heat-transfer paste. The recommended paste is Wakefield 122 Thermo Compound, CDC Part No. 51003962.

DISPLAY ADJUSTMENT

Display adjustments appear in the sequence required for initial setup. When fine tuning during preventive maintenance or readjusting after component failure, only those adjustments required for the specific problem need be made. The adjustments are in the following sequence:

- 1) Cathode emission
- 2) D/A reference voltage
- 3) Unblank rise time
- 4) Unblank delay
- 5) Raster size
- 6) Feedback level
- 7) Symbol size and shape
- 8) Intensity adjust
- 9) Keyboard repeat delay

CATHODE EMISSION

Cathode emission must be adjusted so the crt operates in its linear region. The +15- to +110-volt output of the deflection/crt power supply provides cathode bias voltage and is adjusted for proper cathode emission. Adjustment of this voltage should be necessary only when a new crt is installed and during monthly preventive maintenance. Adjustment during preventive maintenance compensates for tube aging. To adjust cathode emission perform the following steps:

- 1) Before installing a new crt, fasten the post accelerator lead so that it will not arc when the high voltage comes on.
- 2) There are two versions of the deflection/crt power supply. Step 2a is for the early design, and step 2b is for the later version.
 - a) This portion of step 2 is applicable to CC545-C/D consoles. Turn on power and measure the +15- to +110-volt output at deflection/crt power supply test point TP2. Adjust the potentiometer on the supply fully counterclockwise (the voltage should go to +100 volts). Upon rotating the potentiometer clockwise, at some point the output will go to approximately +20 volts. Turn the potentiometer clockwise for maximum output, approximately +110 volts.
 - b) This portion of step 2 is applicable to CC545-E/F consoles. Turn on power and measure the +15- to +110-volt output at the deflection/crt power supply test point TP2. Adjust the potentiometer on the supply fully counterclockwise (the voltage should go towards approximately +15 volts and, at some point in turning counterclockwise, the +420 volts and +700 volts are disconnected from the crt). Upon rotating the potentiometer clockwise, at some point the +420 volts and +700 volts are reconnected to the crt. Turn the potentiometer clockwise for maximum output, approximately +110-volts.
- 3) Turn power off and install the crt.
- 4) Turn power on and slowly decrease the low-voltage output (counterclockwise potentiometer rotation) until a spot appears on the crt.
- 5) Increase the voltage until the spot just extinguishes. Cathode emission is now properly adjusted.

D/A REFERENCE VOLTAGE

Using the oscilloscope, put a probe on the test point on the 4AKD card in location C14. Check for +5 volt dc ± 0.25 volt dc at this test point. If it is not present check for +20 volt dc from the ± 20 volt dc power supply. If the +20 volt dc is present but not the +5 volt dc on the 4AKD test point, replace the 4AKD card.

UNBLANK RISE TIME

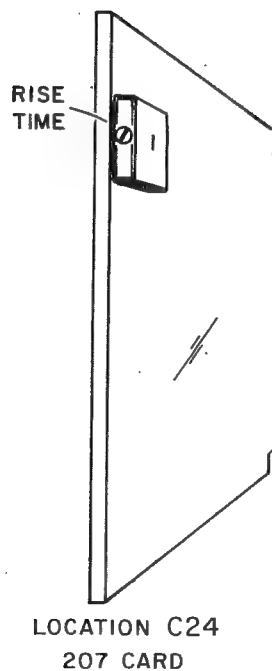
The unblank amplifier, figure 6-3, unblanks (turns on) and blanks (turns off) the crt beam by controlling the voltage level on the control grid.

- 1) Display a raster of symbols.
- 2) Connect the oscilloscope to TPA of the unblank amplifier card at location C24.

NOTE

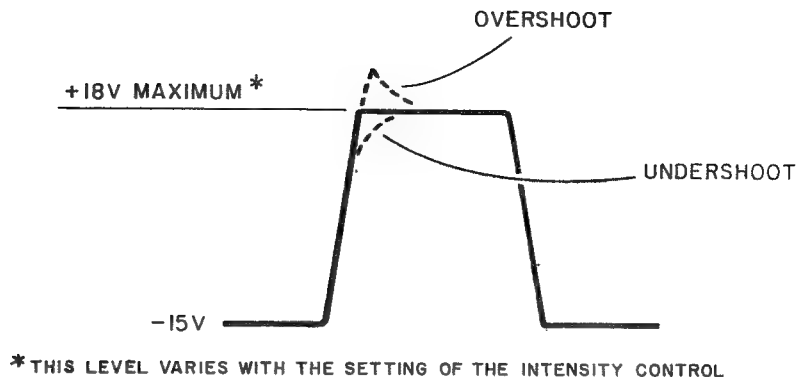
The intensity potentiometer on the operator panel should be turned fully clockwise while making the following adjustment.

- 3) Adjust potentiometer 1 on the 207 card for optimum rise time with minimum overshoot, figure 6-4.



01358

Figure 6-3. Unblank Amplifier



01358

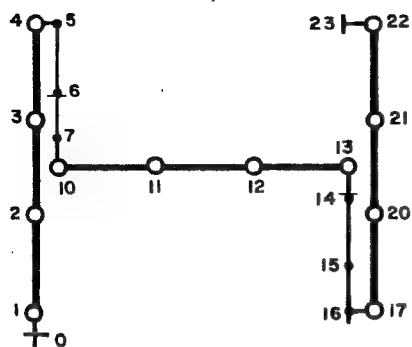
Figure 6-4. Unblank Pulse

UNBLANK DELAY

The ideal timing relationship between the unblank pulse and the analog symbol deflection signal should be such that the unblank signal reaches 90 percent of its peak amplitude just as the deflection signal starts to move the beam for a stroke to be displayed. Figure 6-5 shows the relationships between the unblank signal and the outputs from the +Y and +X deflection amplifier while painting the character H.

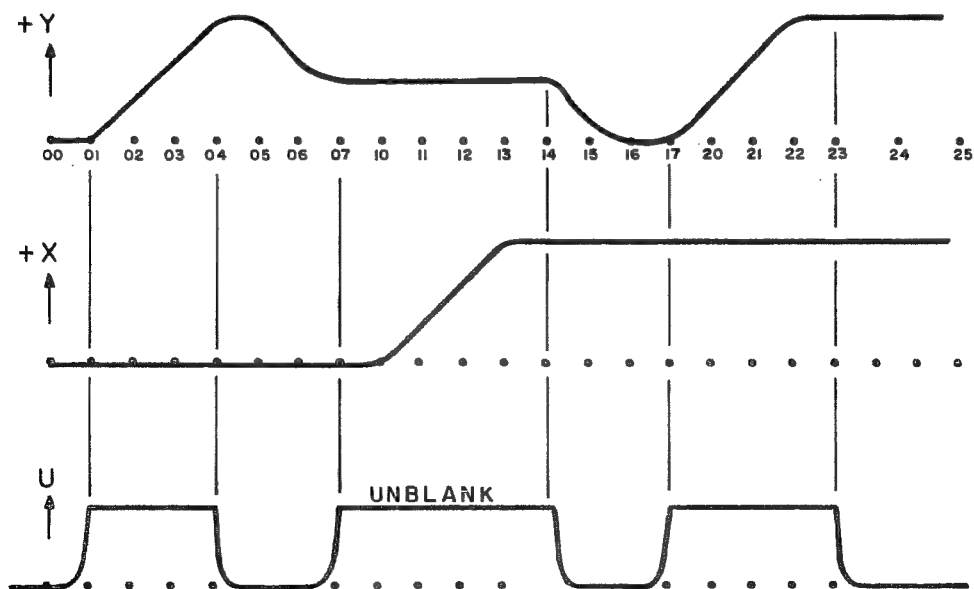
The unblank receiver cards in locations C22 and C23 each have a delay line tapped in 10-nanosecond increments with a maximum of 100 nanoseconds total delay.

Display a pattern of H's on the crt and scope the 207 card test point in location C24. Also scope the +Y output of the deflection amplifier (TB2-6). Tap the delay line on the unblank receiver card in location C22 (right) or C23 (left) depending on the LEFT/RIGHT PRESENTATION switch setting to best achieve the ideal situation described. Scope the +X output of the deflection amplifier (TB1-6) and check that this tap position is also the best setting for the signal. Use current probe or look at input to the deflection amplifier.



V_1 = SINGLE VERTICAL MOVE
 V_2 = DOUBLE VERTICAL MOVE
 H_1 = SINGLE HORIZONTAL MOVE
 H_2 = DOUBLE HORIZONTAL MOVE
 U = UNBLANK (ALTERNATELY ON/OFF)
 $V_1 \bullet V_2$ = REVERSE VERTICAL DIRECTION
 $H_1 \bullet H_2$ = REVERSE HORIZONTAL DIRECTION

H	IO				
T	V_1	V_2	H_1	H_2	U
00					X
01		X			
02		X			
03		X			
04	X	X			X
05		X			
06	X				X
07					
10				X	
11				X	
12				X	
13					
14		X			X
15	X				
16	X	X			X
17		X			
20		X			
21		X			
22					
23					X
24					
25					

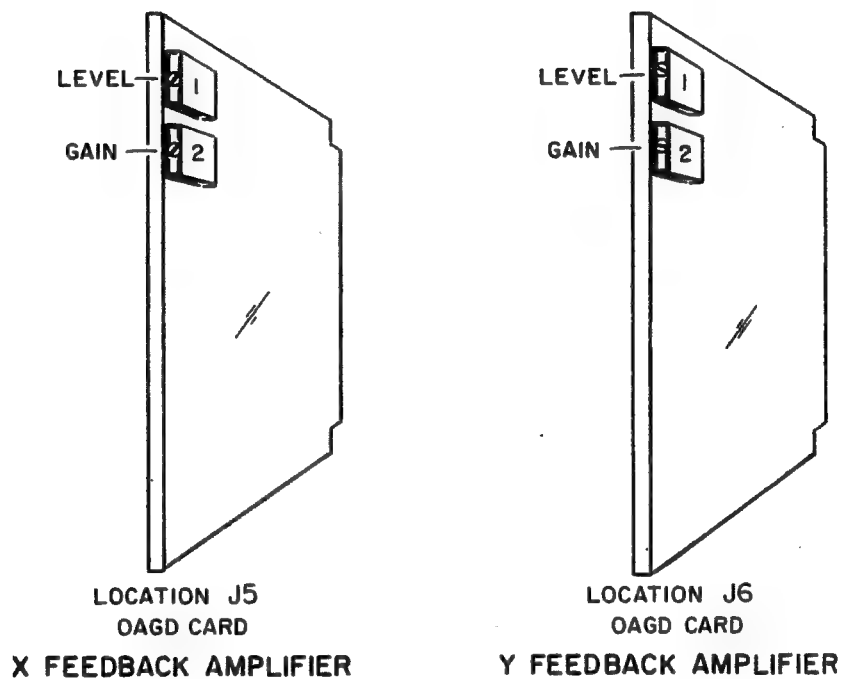


01359

Figure 6-5. Unblank Delay Adjustment

RASTER SIZE

In the monitor, feedback amplifiers (OAGD cards) supply push-pull X and Y base positioning signals to the deflection amplifier. Amplitude of feedback amplifier outputs control deflection yoke current via the deflection amplifier. Adjustment of feedback amplifier gain limits the maximum deflection current change and therefore the display area size. Figure 6-6 shows the feedback amplifier gain adjustment controls.



D1358

Figure 6-6. Feedback Amplifier Adjustments

- 1) Display a full raster of H's in normal mode.
- 2) Adjust potentiometer 2 at J5 for 8 inches along the X axis.
- 3) Adjust potentiometer 2 at J6 for 8 inches along the Y axis.

FEEDBACK LEVEL

For distortion-free display at the corners of the display area, the feedback amplifiers must operate within their linear output range. Figure 6-7 shows typical feedback amplifier waveforms with a raster of symbols.

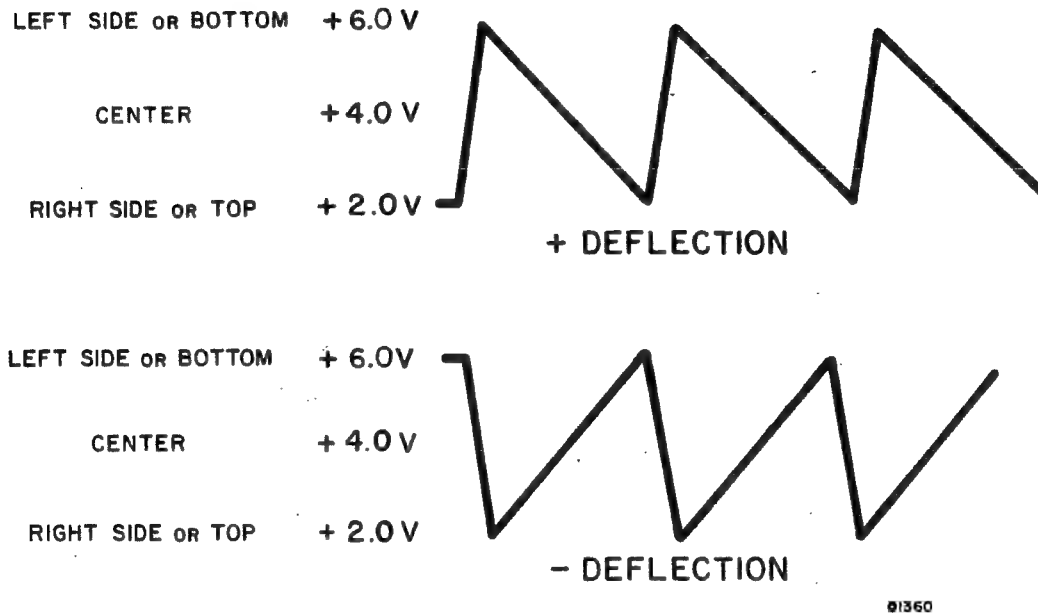


Figure 6-7. \pm Feedback Amplifier Waveforms

- 1) Display a raster of H's in normal mode beginning at the upper left corner of the raster.
- 2) Center the display with the HORIZ and VERT CENTERING controls.
- 3) Adjust X feedback level.
 - a) Scope the +X output, J5-TP1, with CHANNEL A.
 - b) Scope the -X output, J5-TP12, with CHANNEL B.
 - c) Adjust potentiometer 1 at J5 until the bottoms of the waveforms are at a +2.0-volt level.
- 4) Adjust Y feedback level.
 - a) Transfer the CHANNEL A and CHANNEL B probes to J6-TP1 and J6-TP12. These are the +Y and -Y outputs, respectively.
 - b) Adjust potentiometer 1 at J6 until the bottoms of the waveforms are at a +2.0-volt level.

- 5) Observe the upper left corner and the edges of the raster for distortion.
- 6) Determine whether horizontal, vertical, or both feedback level adjustments are incorrect by rotating the HORIZ and VERT CENTERING controls on the monitor to their clockwise and counterclockwise extremes.
 - a) If distortion varies with horizontal position, adjust the X feedback amplifier level for no distortion at either extreme of the HORIZ control.
 - b) If distortion varies with vertical positions, adjust the Y feedback amplifier level for no distortion at either extreme of the VERT control.

SYMBOL SIZE AND SHAPE

Display a pattern of H's and Z's covering the three possible sizes in normal mode. Make all vertical measurements on the character Z and all horizontal measurements on the character H.

- 1) Adjust the potentiometer on the 4ALD card in location C07 until the vertical size of the large Z's is 0.3 inch.
- 2) Adjust the potentiometer on the 5AHD-0 card in location C05 until the horizontal size of the large H's is 0.3 inch.
- 3) Adjust the variable capacitors on the 4ALD cards in location C05 and C07 for best shape of these large characters.
- 4) Adjust the top two potentiometers on the 016D card in location C11 until the vertical size of the small Z's is 0.1 inch.
- 5) Adjust the top two potentiometers on the 016D card in location C03 until the horizontal size of the small H's is 0.1 inch.
- 6) Adjust the bottom two potentiometers on the 016D card in location C11 until the vertical size of the medium size Z's is 0.2 inch.
- 7) Adjust the bottom two potentiometers on the 016D card in location C03 until the horizontal size of the medium size H's is 0.2 inch.

INTENSITY

To adjust intensity, perform the following:

- 1) Display section 1 of SMM test DS1. This section provides a display with a refresh rate of 20 ms. (A different pattern may be used; however, it must have a 20-ms refresh rate in order to achieve a proper intensity adjustment.)
- 2) Turn the +15 volt dc to +110 volt dc adjustment on the deflection/crt power supply fully clockwise.

- 3) Turn the INTENSITY knob on the monitor base fully counterclockwise.
- 4) Adjust the cathode voltage. With the INTENSITY knob fully counterclockwise, adjust the cathode bias voltage counterclockwise until the test pattern appears on the crt, then turn it back clockwise again until the pattern just disappears. At this point there will be full intensity control with the intensity potentiometer.
- 5) Turn the INTENSITY knob fully clockwise.
- 6) Adjust the three individual potentiometers on the 4APD-1 card in location C25 so that the large, medium, and small characters are at the same intensity.

KEYBOARD REPEAT DELAY

Using a programmed display which performs a keyboard echo routine, adjust the potentiometer on the 4AJD card in location A03 for the desired keyboard keycode repeat delay. The normal delay before the depressed key begins to repeat is 3 seconds. The initial delay, however, can be adjusted between 1 to 3 seconds.

MAINTENANCE MODE

In the normal mode the raster size is an 8-inch square centered within the 12- by 12-inch useful area of the crt. In the maintenance mode, the raster size is an 8- by 12-inch rectangle centered within the 12- by 12-inch useful area. The left and right positions of the Presentation switch enable the selection of the named presentation for single display on the crt. The maintenance (middle) position allows the operator to view both right and left presentations simultaneously with the symbols at a reduced size. Figure 6-8 shows the gross positioning addressing for the maintenance mode. In normal mode the gross positioning is accomplished by 9-bit X and 9-bit Y digital inputs. In the maintenance mode a tenth X positioning bit called the Screen Select is used. The Screen Select is used as the highest order X-axis gross positioning bit. In maintenance mode with the Screen Select signal at a logic 1 and all other gross deflection lines at logic 0, the lower left corner of the left display presentation is addressed; with the Screen Select and all other gross deflection lines at 0, the lower left corner of the right display presentation is addressed (figure 6-8).

To test operation in the maintenance mode, place the Presentation switch in the middle (maintenance) position and display a pattern of H's and Z's covering the three possible sizes. Figure 6-9 shows the relative symbol sizes. Adjust symbol size/shape as described previously so that the displayed symbols fit maintenance mode dimensions.

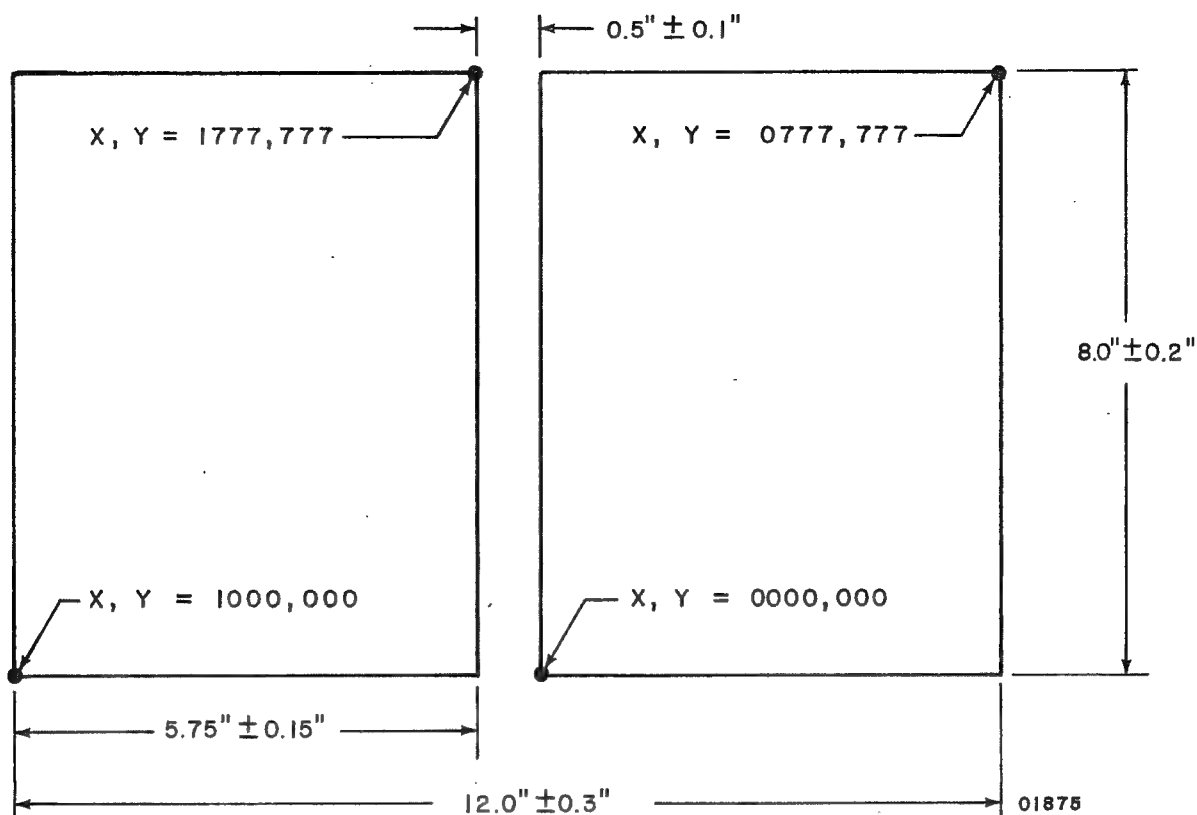
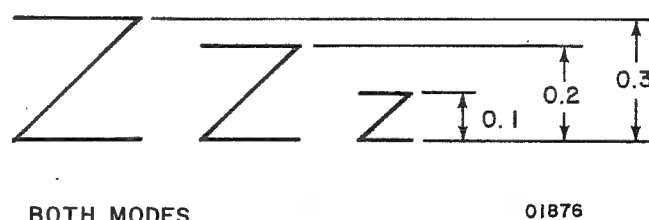
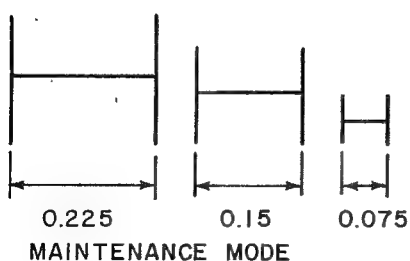
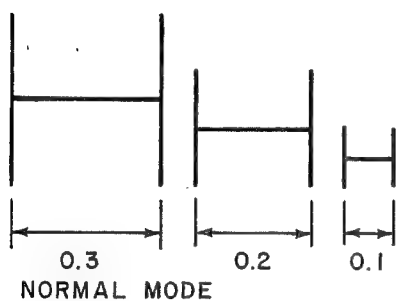


Figure 6-8. Gross Position Addressing, Maintenance Mode;
X, Y Coordinates Octal (Base 8)



NOTE: MEASUREMENT IN INCHES. ALLOWABLE TOLERANCE IS $\pm 10\%$ FOR ALL SYMBOL SIZES EXCEPT FOR LARGE SIZE SYMBOLS IN NORMAL MODE. TOLERANCE ON LARGE SIZE SYMBOLS IN NORMAL MODE SHALL BE $+10\%$
-0

Figure 6-9. Comparative Symbol Sizes and Dimensions

POWER SUPPLY ADJUSTMENTS

Power supply adjustments presented here are for the +20-volt, -20-volt, and high-voltage power supplies. The only adjustment on the deflection/crt power supply is the +15- +110-volt output and this is covered earlier in this section under adjustment of cathode emission.

± 20 -VOLT POWER SUPPLY

Using a multimeter and the test points provided on the power supply assembly, (figure 6-10), adjust potentiometer R1 for +20 volts and potentiometer R2 for -20 volts. When replacing either of the supplies on the ± 20 -volt power supply assembly, turn the variable resistor on that supply fully clockwise before installation. This gives the associated external potentiometer, R1 or R2, control of the full output voltage range.

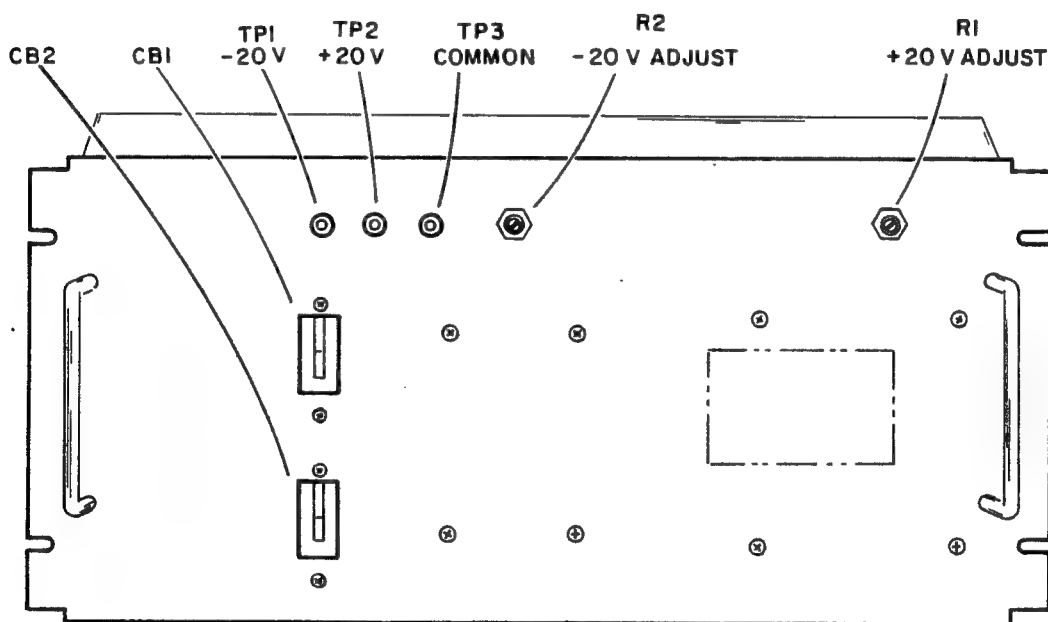


Figure 6-10. ± 20 -Volt Power Supply Assembly

01303

HIGH-VOLTAGE SUPPLY

There are two versions of the high-voltage supply. The early design (part number 61369600) contains potentiometers to adjust for feedback, balance, and high-voltage output. The later design (part number 51918275) contains one potentiometer to adjust for high-voltage output. Both versions are identical as far as input and output hookup and +18 kilovolts output voltage. The two high-voltage supplies are interchangeable. This adjustment procedure is repeated in two parts to accommodate two versions of high-voltage supplies. Each description is identified with the part number of the supply it describes.

The crt specifications require +18 kilovolts on the post accelerator anode, and because of this, the voltage output of the early and later version supply should not exceed this value.

WARNING

After replacing a high-voltage supply, apply power to the station and measure the output voltage before connecting the post accelerator lead to the crt. If the output is high, decrease it to +18 kilovolts.

PART NUMBER 61369600 ADJUSTMENT

To adjust for feedback, balance, and correct high-voltage output, perform the following:

- 1) Before adjusting the output, adjust the chopper output with the balance and feedback potentiometers on top of the supply.
 - a) Scope the collector of chopper transistor Q1 or Q2. These transistors are mounted on the back of the supply and the transistor mounting screws are the collector test points, (figure 6-11).
 - b) Adjust the feedback potentiometer (figure 6-11) on top of the supply for a square wave period of approximately 30 microseconds, figure 6-12.
 - c) Adjust the balance potentiometer (figure 6-11) on top of the supply for equal positive and negative peaks on the square wave, figure 6-12. (If perfectly balanced, however, the chopper will not oscillate and there will be no high voltage generated.)

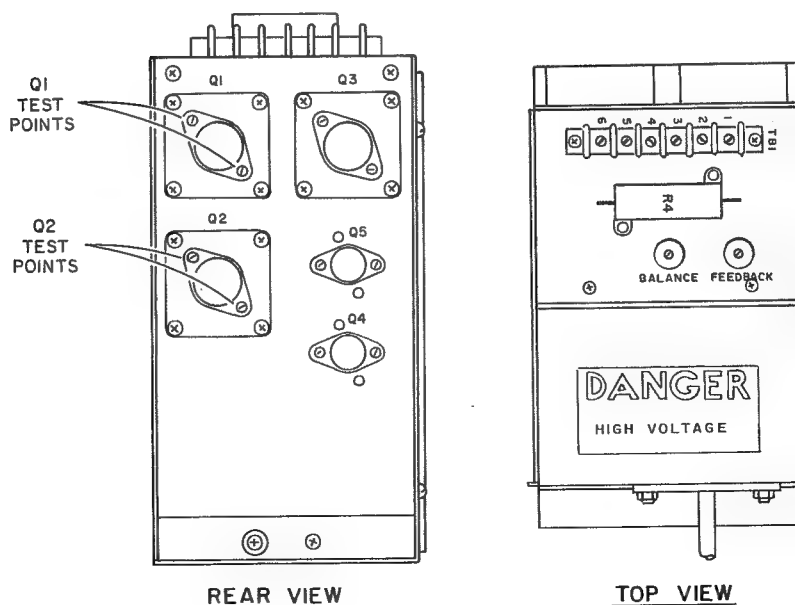
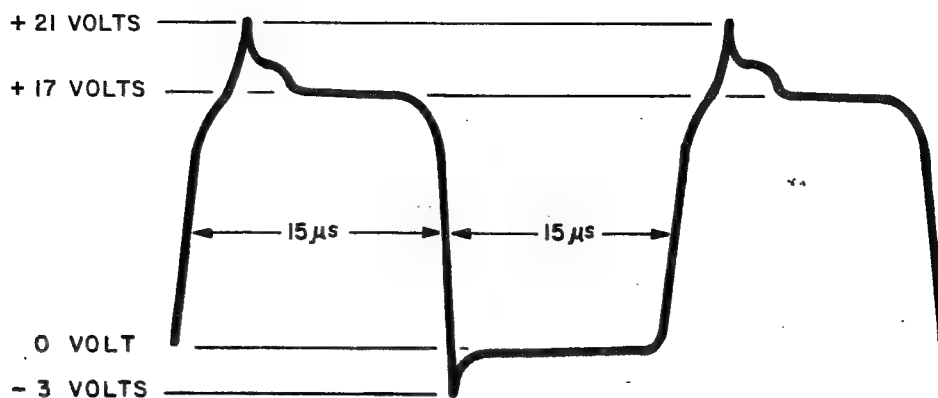


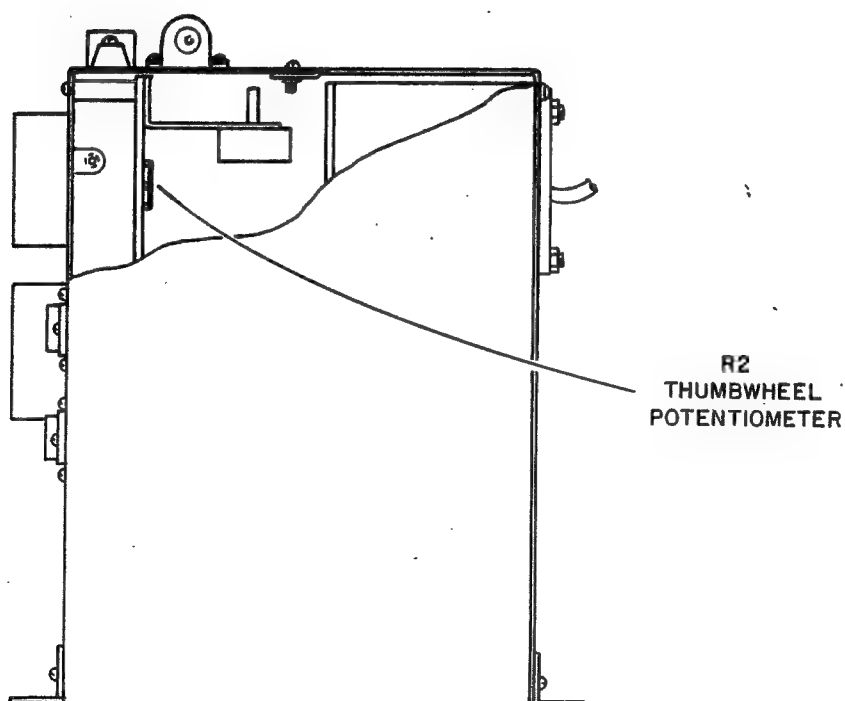
Figure 6-11. Part Number 61369600 High-Voltage Supply, Rear and Top Views



01360

Figure 6-12. Chopper Output Waveform

- 2) Measure the high-voltage output with a multimeter and high-voltage probe. Set this output to +18 kilovolts with thumbwheel potentiometer R2 on 9BCD card within the high-voltage supply, figure 6-13. Adjust R2 with a well insulated screwdriver, USING EXTREME CARE. Clockwise rotation increases the high-voltage output.
- 3) After adjusting the high-voltage output, it may be necessary to go back and peak up the balance and feedback.



01361

Figure 6-13. Part Number 61369600 High-Voltage Supply, Left Side View

PART NUMBER 51918275

To adjust the high-voltage output, perform the following:

- 1) Turn power off and disconnect ac power cord.

CAUTION

The high-voltage supply operates at a lethal potential. Before touching the high-voltage and crt use a correctly rated multimeter and high-voltage probe to verify the absence of high-voltage. If residual high-voltage is found, hold the probe on the voltage point and the multimeter will provide a safe discharge path.

- 2) Pull the high-voltage lead rubber cover (figure 6-13.1) off the crt anode and gently compress the spring-loaded anode lead to release it from the crt.
- 3) Attach high-voltage probe to spring-loaded anode lead and prepare to measure the output voltage with a multimeter.
- 4) Connect ac power cord and turn power on. Wait at least 60 seconds for the display station to warm up.
- 5) Measure the high-voltage output. The output voltage reading should be +18 kilovolts.
- 6) To set the output voltage to +18 kilovolts, adjust the potentiometer labeled ADJUST on the high-voltage supply, figure 6-13.1. Adjust potentiometer with an insulated screwdriver to obtain correct reading.
- 7) Turn power off, disconnect ac power cord and perform discharge procedure described in step 2.
- 8) Connect high-voltage lead to anode of cathode-ray tube.

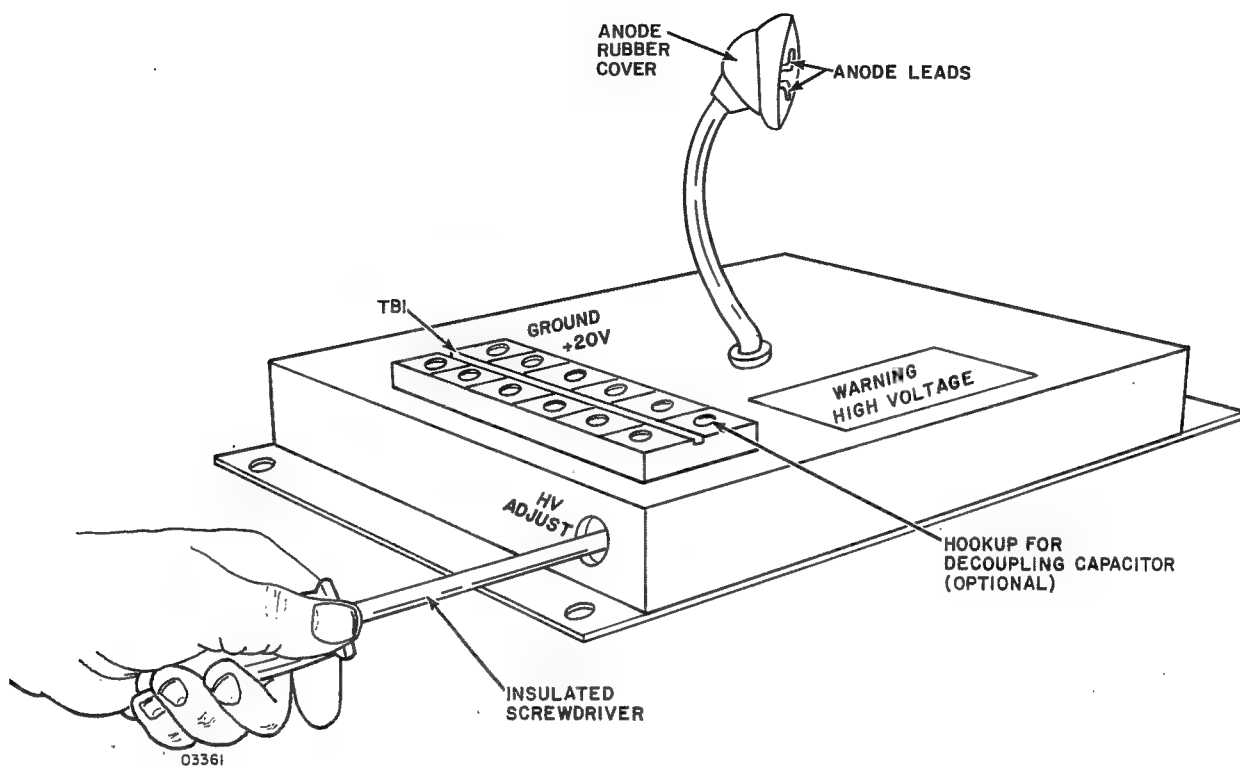


Figure 6-13.1. Part Number 51918275 High-Voltage Supply

REMOVE/REPLACE PROCEDURES

The remove/replace procedures cover removal, installation, and adjustment of the monitor crt and yoke assemblies.

CRT REMOVAL AND INSTALLATION

Wear safety glasses and use utmost care during crt removal and installation. Hands should be clean, dry, and free of any slippery material. Do not use gloves. Before removing the crt from the monitor, prepare a place to set the crt.

WARNING

Dangerously high voltages supply the crt during operation. Be certain that power is off and residual voltage discharged before attempting installation or removal.

Removal

Remove the crt as follows:

- 1) Cover a work area near the station with clean protective padding on which the crt will be placed face down.
- 2) Press the POWER OFF switch and place station circuit breakers CB1 and CB2 in the OFF position.
- 3) Put on safety glasses!
- 4) Remove the monitor hood by sliding it towards the back of the monitor.
- 5) Remove the four Phillips-head screws securing the monitor trim bezel and lift it off.
- 6) Using the multimeter and high-voltage probe, discharge the post accelerator output of the high-voltage supply.
- 7) Disconnect the post accelerator lead from the crt.
- 8) Unplug the crt base connector.
- 9) Loosen the adjustment screw on the steel strap around the front of the crt and carefully remove the crt.
- 10) Place the crt face down on the prepared work surface.

Installation

Install the crt as follows:

- 1) Unpack the crt as shown in figure 6-14.

CAUTION

Before lifting the crt out of the carton discharge the post accelerator anode to the aquadag coating with a meter lead.

- 2) Lift the crt from the carton and carefully insert the neck through the yoke assembly. The post accelerator anode must be at the installer's left.
- 3) With the crt firmly against the yoke, place the adjustable metal strap and two felt pads as shown in figure 6-15. Tighten the adjusting screw until crt is held firmly
- 4) Connect the post accelerator lead from the high-voltage power supply to the crt.

NOTE

Do not attach the crt base connector until instructed to do so.

- 5) Before attaching the crt base connector, turn on CB1 and CB2 on the power control panel and press POWER ON.
- 6) Measure the +15- to +110-volt output of the deflection/crt supply and adjust clockwise for maximum output, approximately +110 volts.
- 7) Press POWER OFF and attach the crt base connector.
- 8) Press POWER ON and slowly decrease (counterclockwise rotation) the +15- to +110-volt output of the deflection/crt supply until a spot appears near the lower corner of the crt. Increase (clockwise rotation) the voltage until the spot just extinguishes.

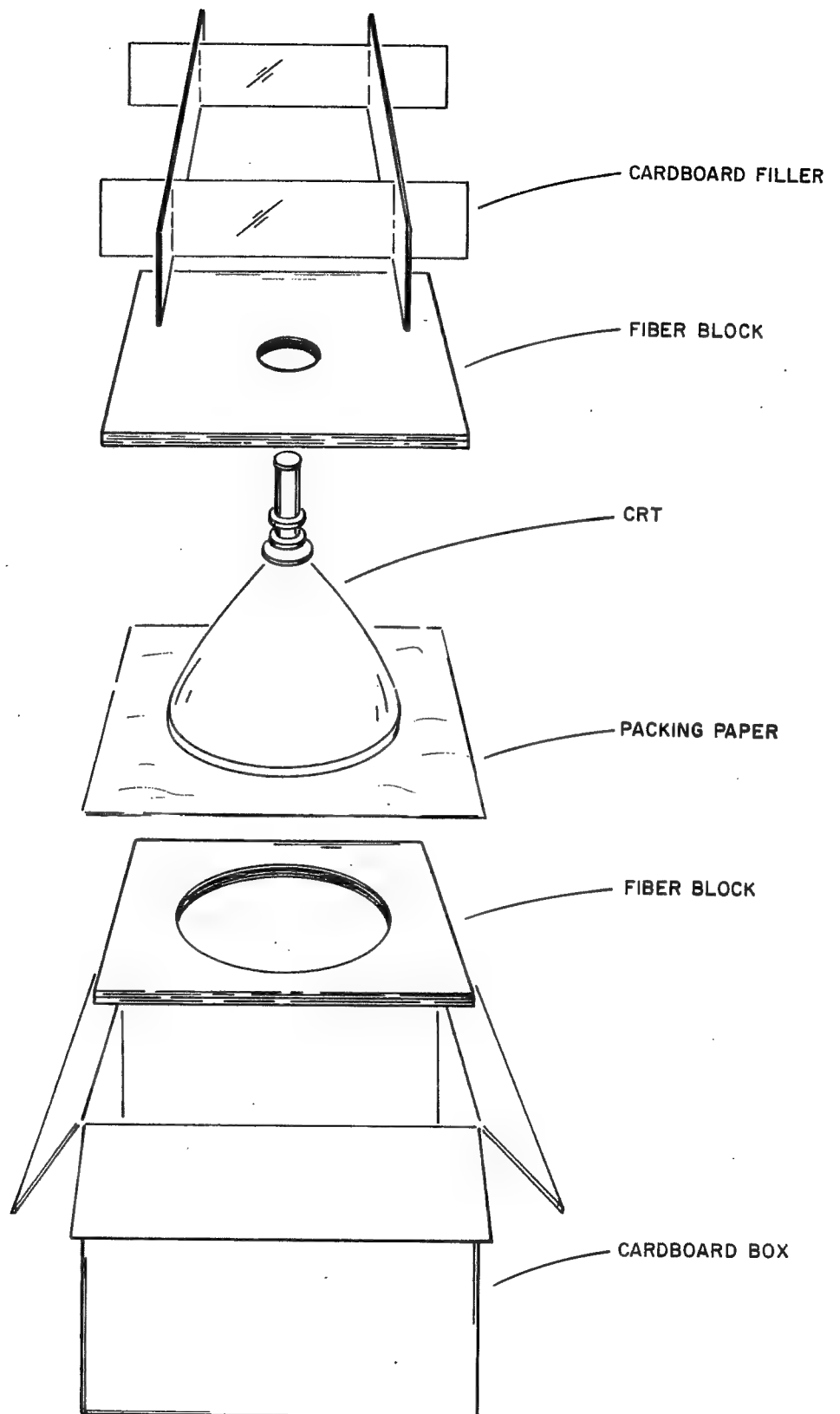
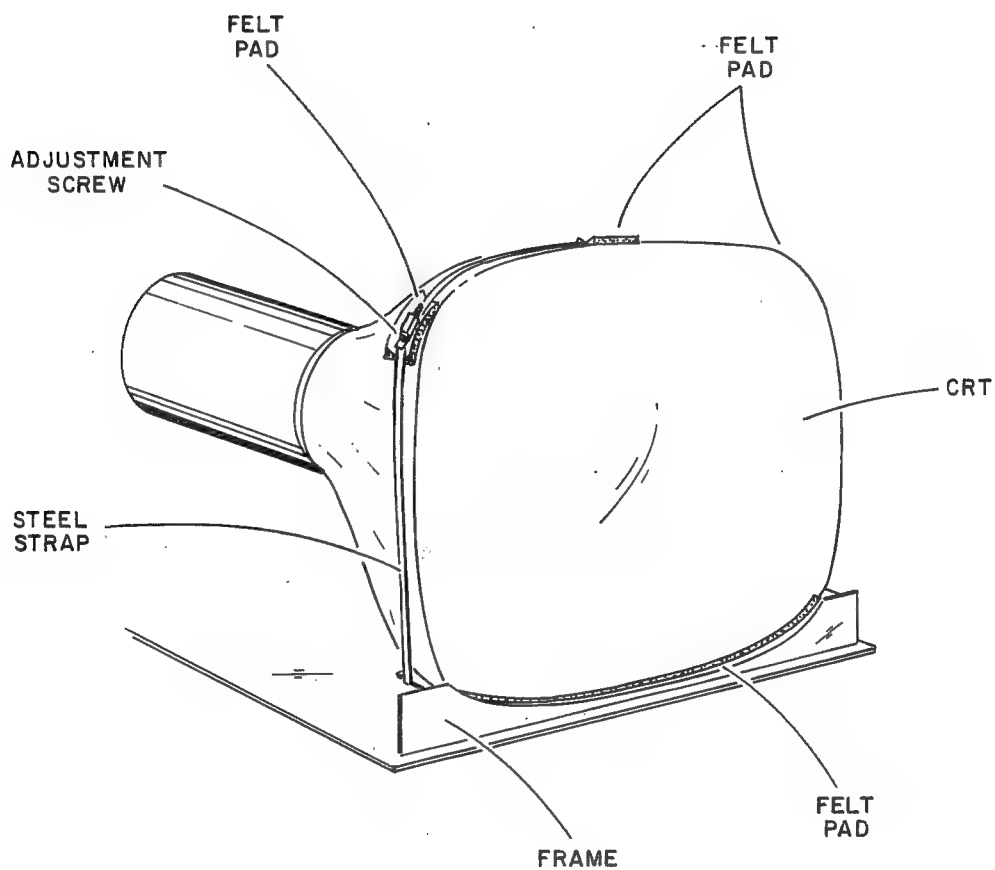


Figure 6-14. CRT Packaging

01362

- 9) Display a raster of symbols and verify that the edges of the pattern are parallel to the edges of the crt. If not, loosen the tube shield and rotate until parallel. Tighten the tube shield.
- 10) Replace the monitor hood.



01363

Figure 6-15. CRT Mounting

YOKE REMOVAL AND INSTALLATION

If the symbol or deflection yoke fails, perform the following procedure for removal and installation. Figure 6-16 shows a breakdown of the crt and yoke assembly.

- 1) Press POWER OFF and place circuit breakers CB1 and CB2 in the OFF position.
- 2) Put on safety glasses.
- 3) Remove the monitor hood by sliding it toward the back of the monitor.
- 4) Using the multimeter and high-voltage probe, discharge the post accelerator output of the high-voltage supply.
- 5) Unplug the crt base connector.
- 6) Loosen the strap securing the tube shield.
- 7) Remove the two screws attaching the tube shield to the yoke mounting block.
- 8) Rotate the yoke until the mounting block is under the crt neck.
- 9) Remove the grommet, holding the yoke leads, from tube shield. Support the crt and yoke while sliding the tube shield off. Let the yoke mounting block rest on the support block.
- 10) Unsolder and mark the yoke leads.

WARNING

Before removing the yoke assembly, the neck of the crt must be securely supported.

- 11) Support the neck of the crt and slide the yoke assembly off the neck. Carefully rest the neck on the support block.
- 12) Remove the three screws mounting the symbol yoke to the positioning yoke. If the symbol yoke is defective, attach a new symbol yoke to the base positioning yoke. In case of a defective positioning yoke, attach the old symbol yoke to a new positioning yoke.
- 13) If the positioning yoke was replaced in step 12, remove the yoke mounting block and strap from the old yoke. Fasten the yoke mounting block and strap to the new yoke before proceeding to step 14.
- 14) Slide the yoke assembly onto the neck of the crt with the yoke mounting block facing down.
- 15) Support the crt by resting the yoke mounting block on the support block.
- 16) Solder on the yoke leads and attach the crt base connector.
- 17) Turn station power on and display a raster of H's.

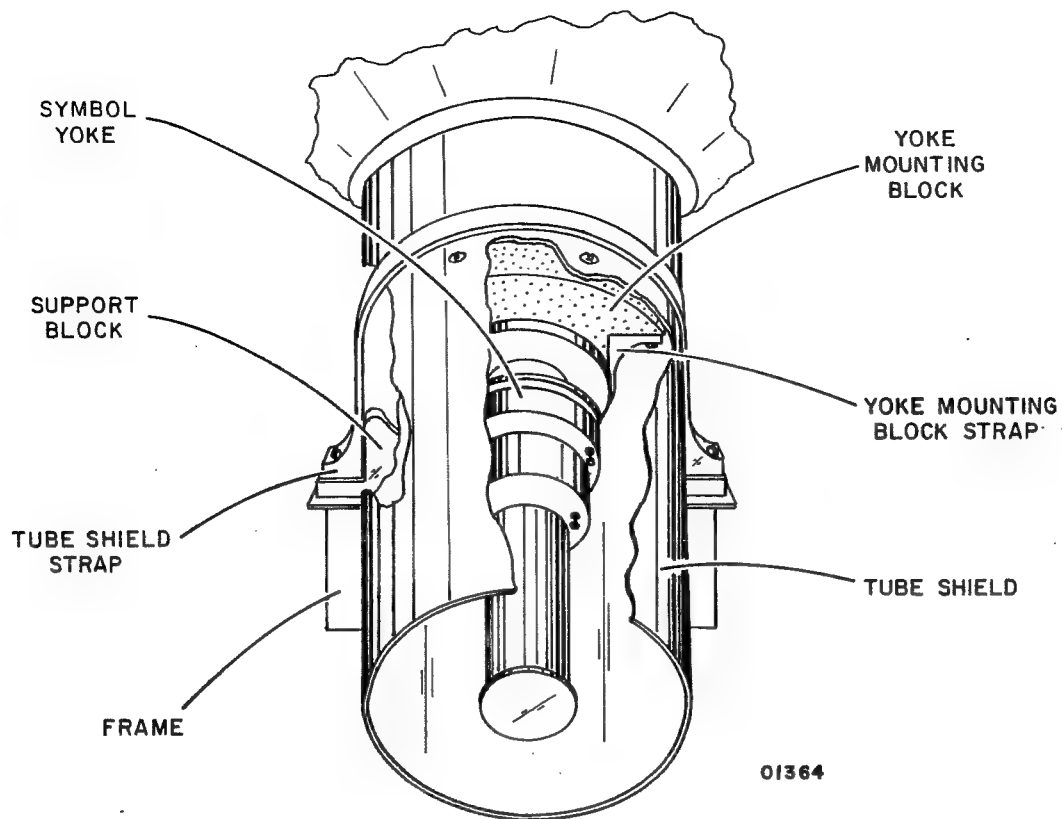


Figure 6-16. CRT and Yoke Assembly, Rear View

- 18) Loosen the three screws securing the symbol yoke and rotate the symbol yoke until the vertical symbol legs are parallel to the vertical edges of the raster. Tighten the three screws on the symbol yoke.

NOTE

At this point, the symbols will be upside down.

- 19) Turn off power and discharge the high-voltage supply as described in steps 1 and 4.
- 20) Unplug the crt base connector and slide the tube shield on with the notch in the shield toward the front of the crt and down.
- 21) Rotate the yoke assembly until the holes in the yoke mounting block line up with the holes in the tube shield. Insert and tighten the screws removed in step 7.
- 22) Slip the yoke lead grommet into the tube shield and attach the crt base connector.
- 23) Turn on power, display a raster of H's, and rotate the tube shield until the pattern is parallel to the crt edges. Tighten the tube shield strap.
- 24) Turn off power and replace the monitor hood.

SECTION 7

MAINTENANCE AIDS

This section lists external cable input/output signals, see table 7-1, and contains a card placement chart and card schematics with an explanation of the operation of each card type.

TABLE 7-1. EXTERNAL CABLE CONNECTIONS

CONNECTOR CABLE	COLOR CODE	PIN	SIGNAL	DIRECTION
A	90	A	⁰ X Deflection	Input
	91	B	¹ X	
	92	C	² X	
	93	D	³ X	
	94	E	⁴ X	
	95	F	⁵ X	
	96	H	⁶ X	
	97	J	⁷ X	
	98	K	⁸ X	
	99	L	⁰ Y	
	900	M	¹ Y	
	910	N	² Y	
	920	P	³ Y	
	930	R	⁴ Y	
	940	S	⁵ Y	
	950	T	⁶ Y	
	960	U	⁷ Y	
B	970	V	⁸ Y Deflection	Input
	90	A	Keyboard ⁰	Output
	91	B	¹	Output
	92	C	²	
	93	D	³	
	94	E	⁴	
	95	F	Keyboard ⁵	
	96	H	Key Down	Output
	97	J	Key Up	
	98	K	Unblank Left Presentation	Input
	99	L	Unblank Right Presentation	
	900	M	Symbol Size Small	Input
	910	N	Symbol Size Medium	
	930	R	Symbol Analog +Y	
	940	S	Symbol Analog -Y	
	950	T	Symbol Analog +X	
	960	U	Symbol Analog -X	Input
	970	V	Dead Start	Output
	980	W	Screen Select	Input

CONTROL DATA							CODE IDENT 15920	SHEET 2			CP	DOCUMENT NO. 61390800			REV. A
LOCATION	LOGIC CARD TYPE	A	B	C	D	FIND NO.	LOCATION	LOGIC CARD TYPE	A	B	C	D	FIND NO.		
A01	C30						A21	4ACD							
A02	4ABD-1						A22								
A03	4AJD						A23								
A04							A24								
A05	4ACD						A25								
A06							A26								
A07	619						B01	C30							
A08	4ACD						B02	002C-3							
A09	619						B03	002C-1							
A10	619						B04	002C-3							
A11	619						B05	002C-3							
A12	C30						B06	002C-5							
A13	4DND						B07	002C-5							
A14	4DND						B08	5ADD-0							
A15	4DND						B09	5ADD-0							
A16	4DND						B10	5AED-0							
A17	C30						B11	5AED-0							
A18	619						B12	C30							
A19	619						B13	9BJD							
A20	619						B14	027							

AA2182

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CONTROL DATA						CODE IDENT 15920	SHEET 3		CP	DOCUMENT NO. 61390800				REV. A
LOCATION	LOGIC CARD TYPE	A	B	C	D	FIND NO.	LOCATION	LOGIC CARD TYPE	A	B	C	D	FIND NO.	
B15	027						C09	016D						
B16	9BJD						C10	620						
B17	C30						C11							
B18	002C-9						C12	4BLD						
B19	002C-9						C13							
B20	002C-7						C14	4AKD						
B21	002C-7						C15							
B22	002C-5						C16	1222RS						
B23	002C-5						C17	1222RS						
B24	002C-3						C18	1222RS						
B25	002C-3						C19	1222RS						
B26	002C-1						C20	1222RS						
C01	C30						C21	1222RS						
C02	620						C22	4AMD						
C03	016D						C23	4AMD						
C04							C24	207						
C05	5AHD-0						C25	4APD-1						
C06							C26	4AND						
C07	4ALD													
C08														

AA3182

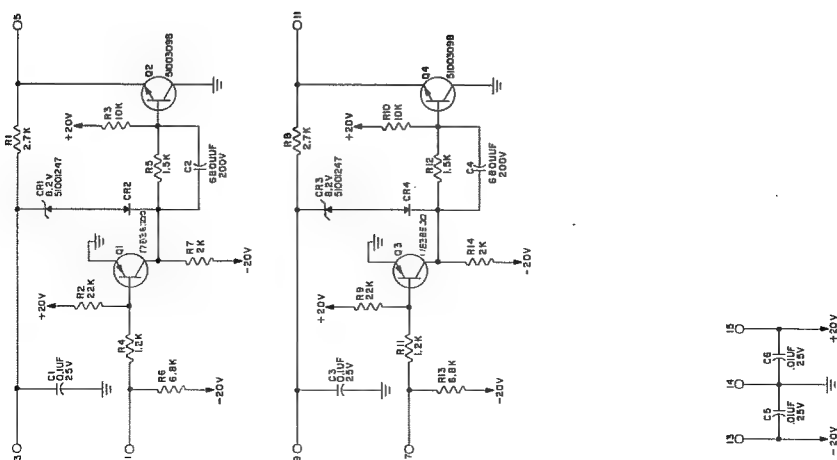
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002C-1 CARD
D/A CONVERTER POSITIONING

<u>Input Pin</u>	<u>Input Level</u>	<u>Output Pin</u>	<u>Output Level</u>
3 and 9	$\approx +5$ vdc	---	---
1 or 7	-0.5 vdc (logical 0)	5 or 11	0 vdc
1 or 7	-3.0 vdc (logical 1)	5 or 11	+5 vdc

A logical 0 input cuts off the input transistor and turns on the output transistor, yielding a 0-volt output. A +5-volt output results when a logical 1 turns on the input transistor and turns off the output transistor.

Tolerances of R1 and R8 decrease with higher order bit positions in a d/a conversion network.



NOTE:
APPLICABLE TO SERIES "B"

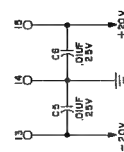
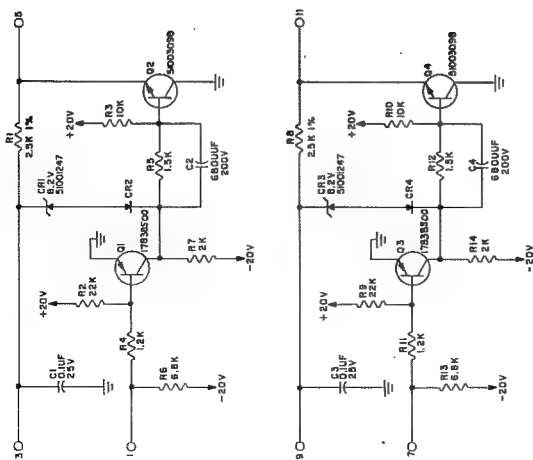
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002C-3 CARD
D/A CONVERTER POSITIONING

<u>Input Pin</u>	<u>Input Level</u>	<u>Output Pin</u>	<u>Output Level</u>
3 and 9	$\approx +5$ vdc	---	---
1 or 7	-0.5 vdc (logical 0)	5 or 11	0 vdc
1 or 7	-3.0 vdc (logical 1)	5 or 11	+5 vdc

A logical 0 input cuts off the input transistor and turns on the output transistor, yielding a 0-volt output. A +5-volt output results when a logical 1 input turns on the input transistor and turns off the output transistor.

Tolerances of R1 and R8 decrease with higher order bit positions in a d/a conversion network.



NOTE:
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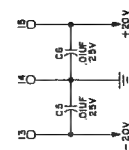
002C-5 CARD
D/A CONVERTER, POSITIONING

<u>Input Pin</u>	<u>Input Level</u>	<u>Output Pin</u>	<u>Output Level</u>
3 and 9	$\approx +5$ vdc	---	---
1 or 7	-0.5 vdc (logical 0)	5 or 11	0 vdc
1 or 7	-3.0 vdc (logical 1)	5 or 11	+5 vdc

A logical 0 input cuts off the input transistor and turns on the output transistor, yielding a 0-volt output. A +5-volt output results when a logical 1 input turns on the input transistor and turns off the output transistor.

Tolerances of R1 and R8 decrease with higher order bit positions in a d/a conversion network.

UNIT NO.	DATE	TIME	BY	REMARKS
10	10/1/64	10:04	100-64	100-64
11	10/1/64	10:04	100-64	100-64
12	10/1/64	10:04	100-64	100-64
13	10/1/64	10:04	100-64	100-64
14	10/1/64	10:04	100-64	100-64
15	10/1/64	10:04	100-64	100-64
16	10/1/64	10:04	100-64	100-64
17	10/1/64	10:04	100-64	100-64
18	10/1/64	10:04	100-64	100-64
19	10/1/64	10:04	100-64	100-64
20	10/1/64	10:04	100-64	100-64
21	10/1/64	10:04	100-64	100-64
22	10/1/64	10:04	100-64	100-64
23	10/1/64	10:04	100-64	100-64
24	10/1/64	10:04	100-64	100-64
25	10/1/64	10:04	100-64	100-64
26	10/1/64	10:04	100-64	100-64
27	10/1/64	10:04	100-64	100-64
28	10/1/64	10:04	100-64	100-64
29	10/1/64	10:04	100-64	100-64
30	10/1/64	10:04	100-64	100-64
31	10/1/64	10:04	100-64	100-64
32	10/1/64	10:04	100-64	100-64
33	10/1/64	10:04	100-64	100-64
34	10/1/64	10:04	100-64	100-64
35	10/1/64	10:04	100-64	100-64
36	10/1/64	10:04	100-64	100-64
37	10/1/64	10:04	100-64	100-64
38	10/1/64	10:04	100-64	100-64
39	10/1/64	10:04	100-64	100-64
40	10/1/64	10:04	100-64	100-64
41	10/1/64	10:04	100-64	100-64
42	10/1/64	10:04	100-64	100-64
43	10/1/64	10:04	100-64	100-64
44	10/1/64	10:04	100-64	100-64
45	10/1/64	10:04	100-64	100-64
46	10/1/64	10:04	100-64	100-64
47	10/1/64	10:04	100-64	100-64
48	10/1/64	10:04	100-64	100-64
49	10/1/64	10:04	100-64	100-64
50	10/1/64	10:04	100-64	100-64
51	10/1/64	10:04	100-64	100-64
52	10/1/64	10:04	100-64	100-64
53	10/1/64	10:04	100-64	100-64
54	10/1/64	10:04	100-64	100-64
55	10/1/64	10:04	100-64	100-64
56	10/1/64	10:04	100-64	100-64
57	10/1/64	10:04	100-64	100-64
58	10/1/64	10:04	100-64	100-64
59	10/1/64	10:04	100-64	100-64
60	10/1/64	10:04	100-64	100-64
61	10/1/64	10:04	100-64	100-64
62	10/1/64	10:04	100-64	100-64
63	10/1/64	10:04	100-64	100-64
64	10/1/64	10:04	100-64	100-64
65	10/1/64	10:04	100-64	100-64
66	10/1/64	10:04	100-64	100-64
67	10/1/64	10:04	100-64	100-64
68	10/1/64	10:04	100-64	100-64
69	10/1/64	10:04	100-64	100-64
70	10/1/64	10:04	100-64	100-64
71	10/1/64	10:04	100-64	100-64
72	10/1/64	10:04	100-64	100-64
73	10/1/64	10:04	100-64	100-64
74				

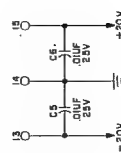


002C-7 CARD
D/A CONVERTER, POSITIONING

<u>Input Pin</u>	<u>Input Level</u>	<u>Output Pin</u>	<u>Output Level</u>
3 and 9	$\approx +5$ vdc	---	---
1 or 7	-0.5 vdc (logical 0)	5 or 11	0 vdc
1 or 7	-3.0 vdc (logical 1)	5 or 11	+5 vdc

A logical 0 input cuts off the input transistor and turns on the output transistor, yielding a 0-volt output. A +5-volt output results when a logical 1 input turns on the input transistor and turns off the output transistor.

Tolerances of R1 and R8 decrease with higher order bit positions in a d/a conversion network.



FD-36 (Rev. 5-22-64)

FILE B	Serial 82197839
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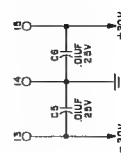
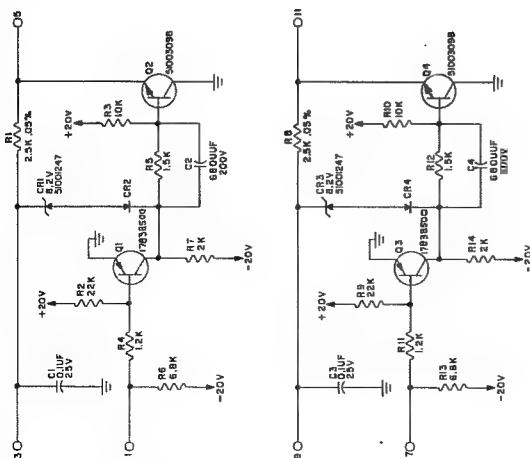
7-11

002C-9 CARD
D/A CONVERTER, POSITIONING

Input Pin	Input Level	Output Pin	Output Level
3 and 9	$\approx +5$ vdc	----	----
1 or 7	-0.5 vdc (logical 0)	5 or 11	0 vdc
1 or 7	-3.0 vdc (logical 1)	5 or 11	+5 vdc

A logical 0 input cuts off the input transistor and turns on the output transistor, yielding a 0-volt output. A +5-volt output results when a logical 1 input turns on the input transistor and turns off the output transistor.

Tolerances of R1 and R8 decrease with higher order bit positions in a d/a conversion network.



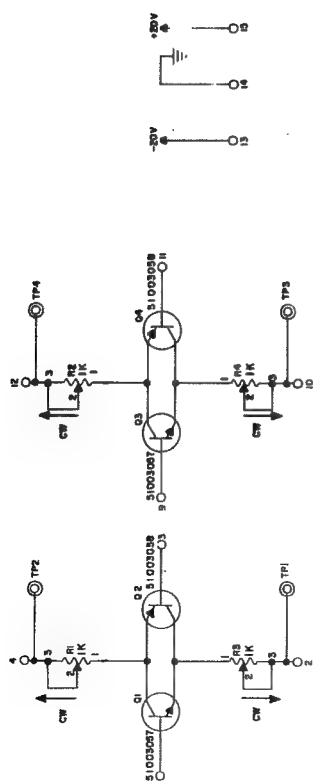
NOTE:
APPLICABLE TO SERIES "B"

82197840

DATE	TIME	SCHEMATIC DIAGRAM, 000C-9	DATA DISPLAY INFORMATION UNIT FILE NUMBER
820917840	820917840		

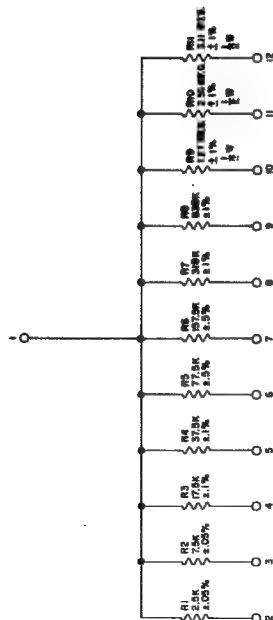
016-D CARD SYMBOL SIZE CONTROL

The 016-D card is used across the symbol lines. The transistor inputs (1, 3 or 9, 11) receive their inputs from the symbol size control lines via the 1222RS inverters. When the associated transistors (Q1, Q2 or Q3, Q4) are turned on, the line is loaded down to a degree dependent on the setting of variable resistors R1 and R2 (or R3 and R4). Input voltages to the 016-D transistors varies from 0 to -3 volts, while the output voltage/current depends on the levels of the associated logic and setting of the variable resistors.



027 CARD D/A RESISTOR NETWORK

This card accepts digital positioning information and converts this information to an analog current. The resulting current is the sum of the individual resistor currents. Considering the source resistance in series with each d/a resistor, the individual resistance combinations are weighted by powers of 2. That is, the resistance for bit 2^1 is half that for 2^0 , etc. Digital information from the lowest order bit feeds the largest resistor, thus creating the smallest analog contribution. Information from higher order bits correspondingly lower resistors, producing larger analog contributions.



NOTE: APPLICABLE FOR SERIES A

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**C30 CARD
FILTER CARD**

This card is used in conjunction with the power supply to provide filtering.



ALL CAPACITORS ARE 150F. 20V. 20V

82198406

BASIC REFERENCE DESIGNATION PREFIX 1A1A5A4 OR 1A1A5A1A

THIS NOTICE FOR BIDDING ON GOVERNMENT PROPOSALS AND CONTRACTS

FIGURE A-37

EMATIC DIAGRAM,
C 30

ATA DISPLAY, MICROSTATE

82198406

CODE 15920

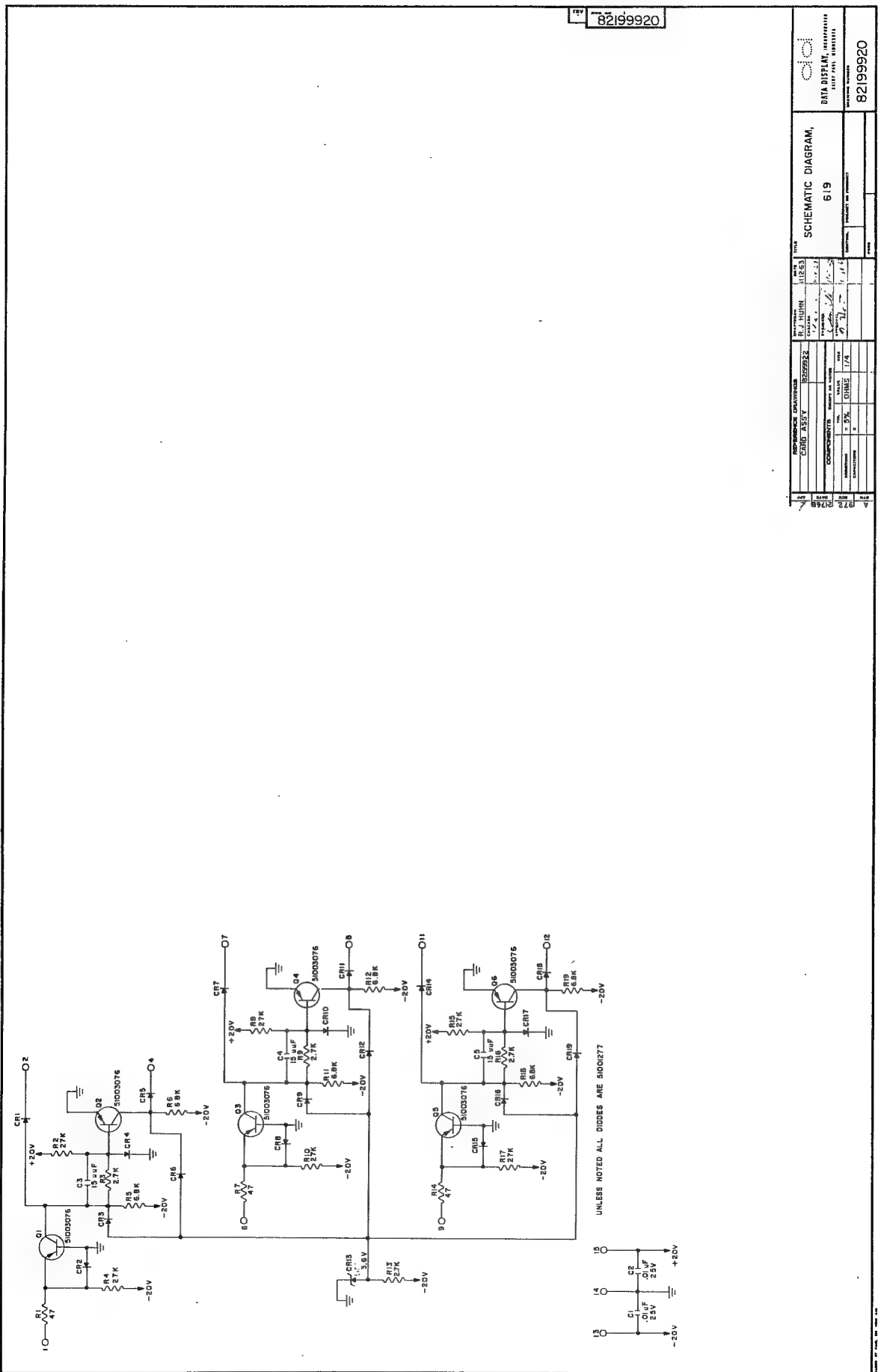
207 CARD UNBLANK TIMING/SHAPING

The 207 card enables a timed unblank pulse to the crt control grid. Q1 and Q3 enable forming and shaping the pulse through Q2. A logical 0 (-0.5v) fed to pin 11 cuts off Q1 and Q3 allowing the collector of Q3 to rise positively until clamped by the input clamping voltage on pin 2. The resulting pulse feeds the crt control grid through Q2, output emitter-follower. This positive pulse unblanks the crt. Output voltage ranges from -15 to +18 volts. Potentiometer R11 adjusts output pulse rise time. Typical operating voltages are:

<u>Input Pin</u>	<u>Input Level</u>	<u>Output Pin</u>	<u>Output Level</u>
2	0 to 20 volts	4	-15 to +18 volts
11	-0.5 to -2.6 volts		

619 CARD LOGIC LINE TERMINATOR

The 619 card is a switching circuit and level shifter which enables the matching of the 72-ohm line to the display station logic. The 619 card receives inputs from 0 volt to +3 volts and outputs 0 volt to -3 volts. The 619 outputs to the 002 d/a converter cards (0 volts disables the associated d/a circuit while -3 volts enables the d/a).

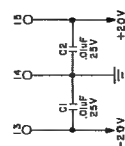


8BMD CARD LOGIC LINE TERMINATOR

The 8BMD card is a switching circuit and level shifter which enables the matching of the 72-ohm line to the display station logic. This card receives inputs from 0 volt to +3 volts and outputs 0 volt to -3 volts. The 8BMD outputs to the 002 d/a converter cards (0 volts disables the associated d/a circuit while -3 volts enables the d/a).

620 CARD ANALOG LINE TERMINATOR

The 620 card is a linear amplifier and level shifter which enables the matching of the 72-ohm line to the display station logic. Inputs range from 0 volt to +3 volts, while outputs are from 0 volt to -3 volts. The 620 card output is to the 4ALD card (symbol deflection amplifier driver) via the size control cards (016-D).

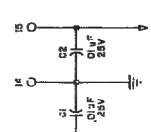
[illegible]

1222RS AND 1222RS-1 CARDS SPECIAL-PURPOSE INVERTERS

The 1222RS and 1222RS-1 cards are inverters used in the symbol size operation. The inverter receives its input from the 619 logic line terminator cards and outputs to the symbol size control cards (016-D) and to the symbol intensity modulation card (4APD-1).

The inverter operates on two distinct signal levels: -3 volts (logical 1) and -0.5 volt (logical 0). A 0 input results in a positive potential to the base of the transistor (Q1), driving Q1 to cutoff. With Q1 cut off, there is a higher voltage drop across the transistor (because of the higher impedance) and less of a drop across R4, resulting in a -3-volt level on the output line. A 1 input drives Q1 away from cutoff, producing a greater voltage drop across the R4 resistor, resulting in a -0.5-volt level on the output line.

The inverter has three types of outputs: standard diode outputs (pins 3 and 4), resistive output (pin 5) and shorted output (pin 6). The diode output isolates the output lines from each other and prevents feedback from connecting circuits. The resistive output is used for tying the output of a standard logic circuit to an analog network of d/a converter. The shorted output is connected directly to the collector of the transistor.

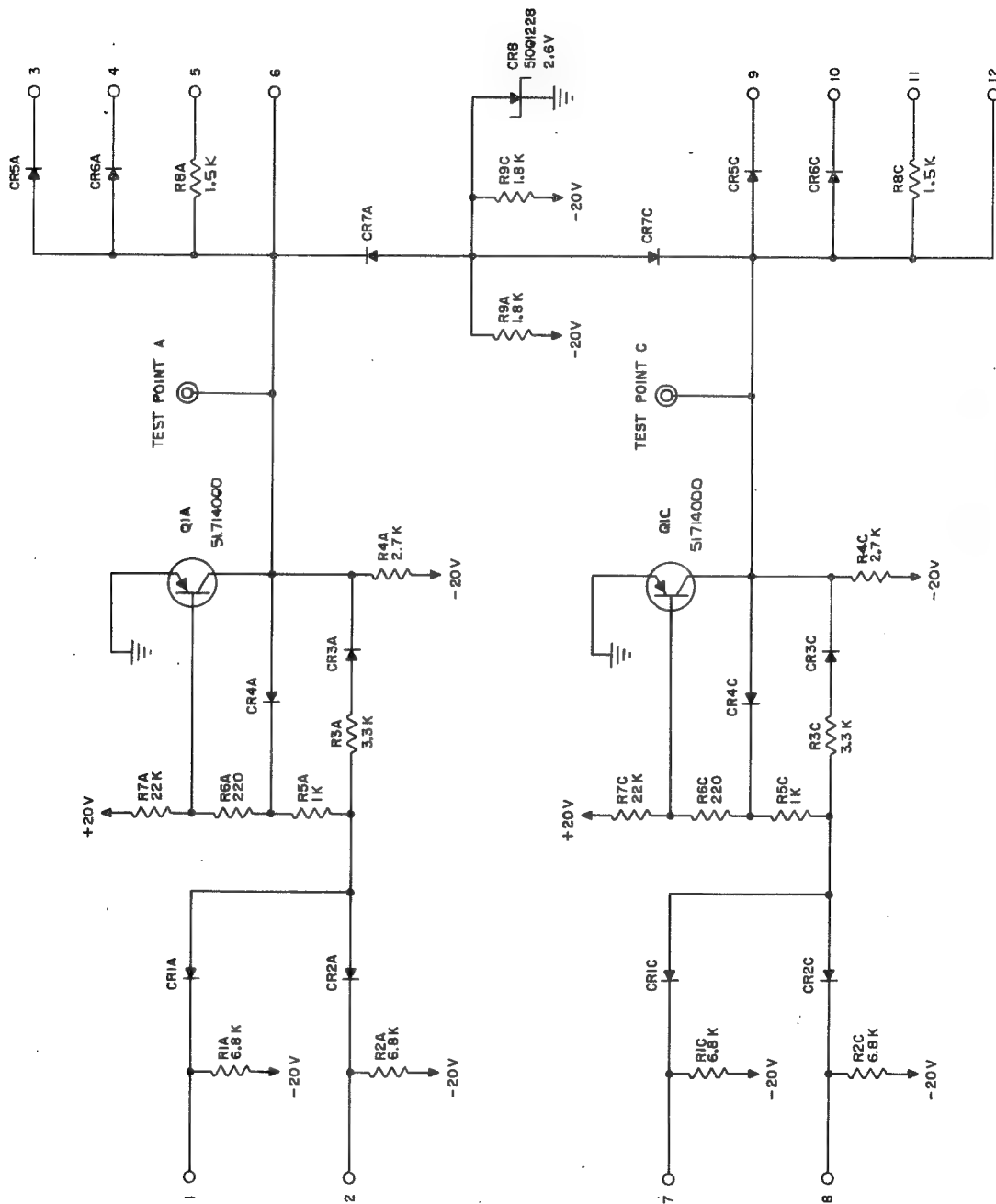


ALL DIODES UNLESS SPECIFIED ARE 5001277

NOTE: THIS CARD REPLACED BY 122RS-1 CARD.

INACTIVE

[illegible]



62952600 L

7-28.1

LOC
CROSS
REF NO

SCHEMATIC DIAGRAM

CODE IDENT
15920

DWG NO
90446011

REV
A

4ABD-1 CARD KEYBOARD INTERFACE

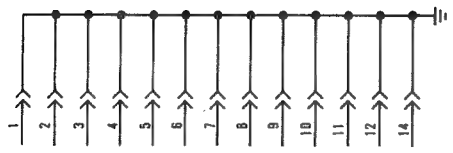
The 4ABD-1 keyboard interface card interfaces the display station keyboard to the computer (via the controller) and isolates the XI module of the controller from the 4AJD card. The operation of a keyboard key encodes a 6-bit octal code which is transmitted to the controller via the 4ABD-1 card. The input signals from the keyboard consist of either an open or a closed circuit (to ground), and the output of the 4ABD-1 card is the same as the input. The logic circuits associated with each signal line isolate the controller from the keyboard.

4ACD CARD GROUND JUMPER

The 4ACD card is a foil-covered card used in this station as a ground jumper. Pins 1 through 12 are connected to pin 14.

1
2
3
4

SHEET REVISION STATUS				REVISION RECORD			
REV	CD	DESCRIPTION	DRFT	DATE	CHKD	APP	
01	9015-1	RELEASED CLASS B	—	9/26/74	—	—	—
A	9015-7	RELEASED CLASS A	—	9/26/74	—	—	—



62952600 A

7-31

90377300

REFERENCE DRAWING		CONTROL DATA		TITLE	
BOARD DETAIL 90377400		FIRST USED ON		SCHEMATIC DIAGRAM 4ACD	
BOARD ASSY 90377500		CC545-A, B		(GROUND JUMPER)	
COMPONENTS EXCEPT AS NOTED		DWG		DRAWING NO	
TOLERANCE		M. TAUBER		15920	
VALUE		2-4-74		C 90377300	
BATING		2-19-74			
RES		2-12-74			
CAP		2-10-74			
		5-3-74			

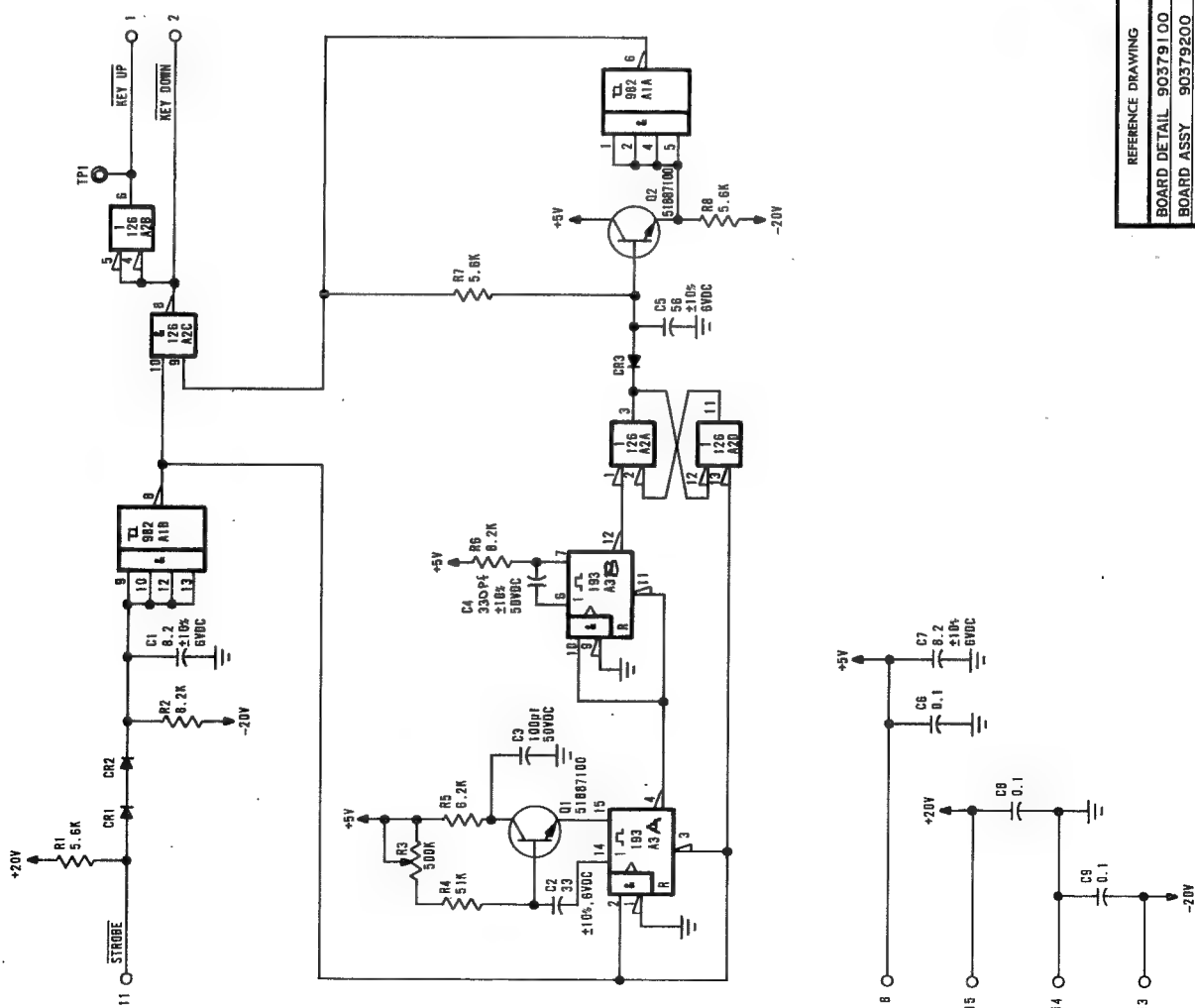
4AJD CARD

KEYBOARD REBOUNCE SUPPRESSOR AND REPEAT OSCILLATOR

The 4AJD card contains circuitry to suppress key bounce and generate a Strobe Out signal whenever the input at pin 11 is grounded (a keyboard key actuated). This card also contains an oscillator to provide a repeat key feature.

The input schmitt trigger is used to suppress key bounce. The operation of a keyboard key causes a ground input at pin 11. A low input at pin 11 will cause the output of the schmitt trigger (A1B-8) to go high after approximately 6 milliseconds (determined by C1 and R2). This generates a Key Down signal. After the delay, the positive-going output of the schmitt trigger fires the one-shot (A3A), causing negative-going pulse from A3A-4 (the duration of this pulse is from 1 to 3 seconds, as determined by R3). The trailing edge of the pulse triggers the one-shot (A3B), and the resulting low from A3B-12 sets the A2A/A2D ff. With the ff set, Q2 oscillates, toggling the Key Up and Key Down signals. This enables the repeated transmission of a character at a 3-Hz (approximately) rate for as long as the key is held down.

SHEET REVISION STATUS				REVISION RECORD			
	REV	CD	DESCRIPTION	DRFT	DATE	CHKD	APP
	Q1	9015-1	RELEASED CLASS B	✓	8-23-74	✓	WCT
	A	9015-7	RELEASED CLASS A	✓	9-14-74	✓	WCT



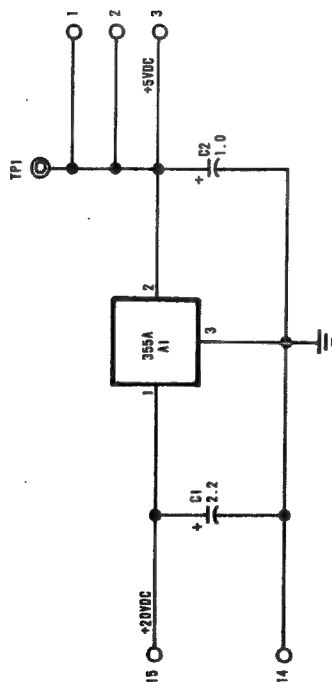
NOTES:

7. UNLESS OTHERWISE SPECIFIED ALL DIODES TO BE 5101/239.
8. UNLESS OTHERWISE SPECIFIED POWER AND GROUND PINS OF INTEGRATED CIRCUITS ARE AS LISTED BELOW:
14 PIN INTEGRATED CIRCUITS: PIN 14 = +5V, PIN 7 = GND.
16 PIN INTEGRATED CIRCUITS: PIN 16 = +5V, PIN 8 = GND.

[illegible]

4AKD CARD +5 VDC POWER SUPPLY

The 4AKD card provides a regulated +5 vdc output from a +20 vdc source. This function is provided by using a monolithic linear IC regulator. Capacitor C1 is an input filter, while C2 is used to improve the output transient response.



SHEET REVISION STATUS										REVISION RECORD						
										REV	CD	DESCRIPTION	DRFT	DATE	CHKD	APP
										01	9015-1	RELEASED CLASS B	—	7/25/74	—	WGT
										A	9015-7	RELEASED CLASS A	—	5/6/74	—	WGT

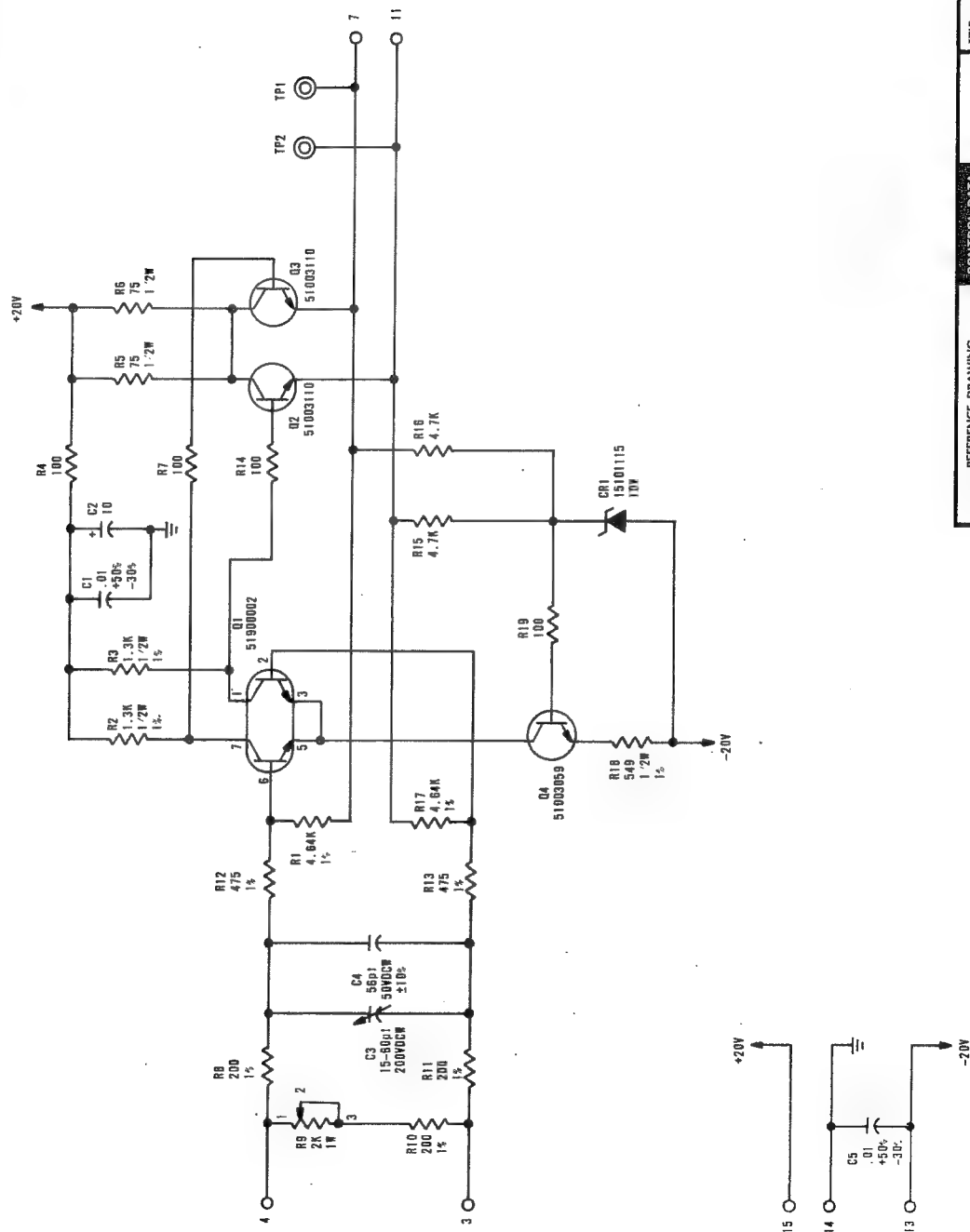
REFERENCE DRAWING		CONTROL DATA		TITLE	
BOARD DETAIL	90379400			SCHEMATIC DIAGRAM 4AKD	
BOARD ASSY	90379500	CC545 A/B		(45V DC POWER SUPPLY)	
COMPONENTS, EXCEPT AS NOTED		CROSS		DRAWING NO	
TOLERANCE	VALUE	CROSS		CODE IDENT	
RES	270K	CROSS		15920	
CAP	35VDC	CROSS		90379300	
		CROSS		DWN	
		CROSS		3/5/74	
		CROSS		3/15/74	
		CROSS		3/15/74	
		CROSS		3/15/74	

4ALD CARD SYMBOL DEFLECTION AMPLIFIER DRIVER

The 4ALD card amplifies push-pull input signals and applies them to the symbol deflection amplifier. The emitter-followers Q2 and Q3 provide current amplification and low impedance for driving the deflection amplifier.

With the push-pull input, an increase on one pin will be accompanied by a decrease on the other input pin. For example, if pin 4 goes negative and pin 3 positive, the portion of Q1 associated with pin 4 conducts less and the other half of Q1 conducts more. Output pins 7 and 11 then go positive and negative respectively. The reverse would be true for opposite polarity swings on input pins 4 and 3. Potentiometer R9 provides symbol size control by controlling the input signal attenuation. Variable capacitor C3 provides symbol smoothness control by regulating the amplifier response time.

SHEET REVISION STATUS				REVISION RECORD			
REV	CO	DESCRIPTION	DATE	CHKD	APP		
01	9015-1	RELEASED CLASS B	3/23/74				
A	9015-7	RELEASED CLASS A	5/16/74				



REFERENCE DRAWING	
BOARD DETAIL	90379700
BOARD ASSY	90379800

CONTROL DATA	
REV	02545 A/B
USED ON	
DOWN	2/21/74
ENGR	7/18/74
APPR	3/14/74
CHKD	3/14/74
DATE	3/14/74

TITLE	
SCHEMATIC DIAGRAM, 4A-D	

CODE IDENT	
15920	

DRAWING NO	
90379600	

SYMBOL DEFLECTION AMP DRIVER	
------------------------------	--

4AMD CARD UNBLANK RECEIVER

The 4AMD card has an adjustable delay (0 to 100 nanoseconds) which allows alignment between the unblank pulse stream and the analog symbol deflection signals. The 4AMD card also provides level shifting to interface with the unblank amplifier (207 card).

Transistor Q1 along with resistors R6 and R7 provides impedance matching at the input of the 100-ohm delay to suppress reflections. The delay line is tapped in 10-nanosecond increments. Pin 6 represents the minimum delay and pin 9 the maximum delay. The emitter-follower circuits (Q2 and R12) provide a high impedance signal pick-off from the delay line. R8 terminates the delay line in its characteristic impedance. The emitter-coupled pair of transistors (Q2 and Q3) along with CR1, CR2, and CR5 provide the level shifting required to interface with the 207 card.

Pull-down resistor R9 ensures that output pin 1 will be forced low (unblank deselected) when the jumper plug is missing. Pull-up resistor R1 ensures that the unblank will be deselected (pin 1 low) when pin 12 is open. Pin 6 is routed to +20 vdc through an external switch, and when pin 6 is open, the circuit is disabled and pin 1 is forced low.

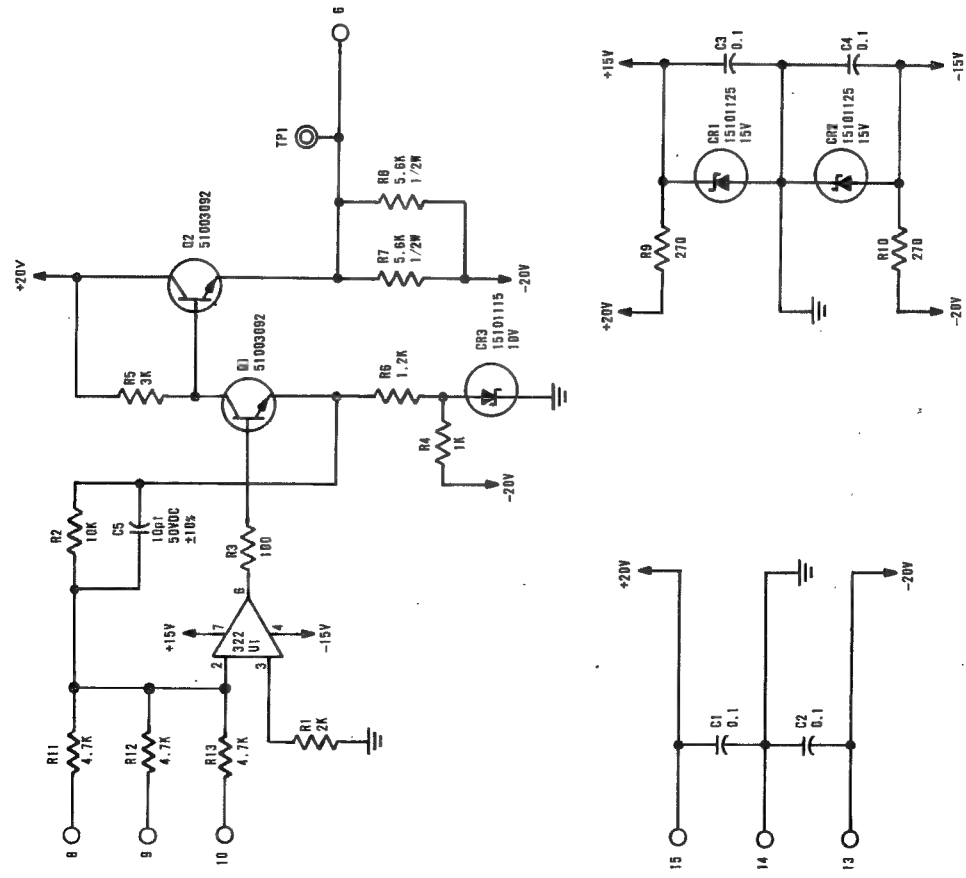
4AND CARD SYMBOL INTENSITY AMPLIFIER

The 4AND card amplifies the size-modulated intensity signal supplied by the 4APD-1 card and applies this signal to the 207 (unblank timing/shaping) card.

U1 is a high-speed operational amplifier that is used as a summing amplifier in this circuit. The 4AND receives its inputs from the 4APD-1 card. Only one of the three possible size signals will be active, while the other two lines will be grounded. Input voltage ranges from 0 to 8 vdc, while the output range is from -1.8 to +10.4 vdc. Q1 limits the output voltage swing, while emitter-follower Q2 provides isolation between Q1 and the 207 card.

4 3 2 1

SHEET REVISION STATUS				REVISION RECORD			
REV	CD	DESCRIPTION	DATE	CHKD	APP		
01	—	REVISED ART WORK	2/2/74	—	—		
A	9015-7	RELEASED CLASS A	2/6/74	—	—		



REFERENCE DRAWING		CONTROL DATA		TITLE	
BOARD DETAIL	90390300	FIRST USED ON	C1545 AEB	SCHEMATIC DIAGRAM 4AND	
BOARD ASSY	90390400	OWN	C 1055	(SYMBOL INTENSITY AMP)	
COMPONENTS, EXCEPT AS NOTED		CHKD	3/5/74	DRAWING NO	
TOLERANCE	VALUE	ENG	3/5/74	CODE WRT	
RES	25%	WPG	3/5/74	15920	
BATING	1/4"	3-7424		C 90390200	

4APD-1 CARD

SYMBOL INTENSITY MODULATION

The 4APD-1 card allows the three possible symbol size selections to independently modulate the symbol intensity level. The card has intensity adjustments for each of the three symbol sizes and an overall adjustment which affects each symbol size equally.

The voltage-divider circuit composed of R1 and R2 provides the overall intensity adjustment capability. The emitter-follower combination of Q1 and R2 ensures that the voltage level at the emitter of Q1 is independent of the symbol size selected.

Only one input (large, medium, or small) should be less than 0.6 vdc at a time. The symbol size thus selected determines which variable resistor (R3 for large, R6 for medium, and R9 for small) remains in the series path between Q1 and the output. Transistors Q2, Q3, and Q4 isolate their associated variable resistors from the output when their symbol sizes are not selected.

9BJD

CURRENT SUMMING AMPLIFIER

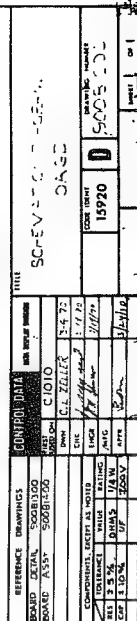
Output voltage at pin 7 reflects the magnitude of the current input to pin 1. Input current ranges from 0 to approximately 2 milliamperes. Corresponding changes in output voltage range from -2 volts to 0 volt. Feedback network R5/C1 controls gain of differential amplifier transistor Q1 and holds the input at pin 1 near ground. Increased input current increases conduction of the left half of Q1 and decreases right half conduction. As a result, Q3 conducts more and pulls the output voltage positive. The reverse is true for a decrease in input current.

0AGD CARD FEEDBACK AMPLIFIER

The 0AGD card is located next to the high-voltage power supply. Inputs to the differential amplifier range from 0 volt to -2.6 volts. By controlling attenuation of the two inputs, potentiometer R3 controls feedback amplifier gain. Increasing resistance increases gain and vice versa. Level control potentiometer R11 varies conduction of current source transistor Q2. Conduction of Q2 determines the dc operation level of the amplifier. Output emitter-followers Q3 and Q4 provide current amplification for driving the deflection amplifier.

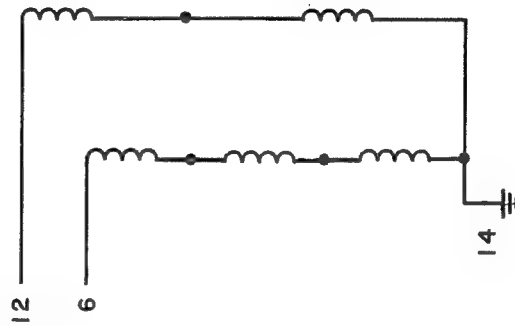
Zener diodes CR2 and CR3 limit deflection amplifier current by clamping the maximum emitter-follower input at +10 volts. This provides current protection for the deflection amplifier output transistors. The output voltage at pins 4 and 44 swings 2.5 ± 0.5 volts around a +4-volt dc level in normal mode, and ± 3 volts around a 4 vdc level in the maintenance mode. Pins 16 and 36 receive negative feedback signals from the deflection amplifier. The feedback voltage is 180 degrees out of phase with the differential amplifier inputs, stabilizing the amplifier and improving frequency response. In practice, a 1K potentiometer connects across pins 8 and 40 with the center tap connected to pin 32. This provides centering control by unbalancing the bias voltages on the bases of dual transistor Q1. After the raster size and feedback level adjustments have been performed as described in Section 6, inputs and outputs for one half of the amplifier (swing voltage, peak-to-peak, $\pm 5\%$) have the following relationship.

<u>Input</u>	<u>Output</u>
-2 volts	+6 volts
-1.7 volts	+4 volts
0 volt	0 volt



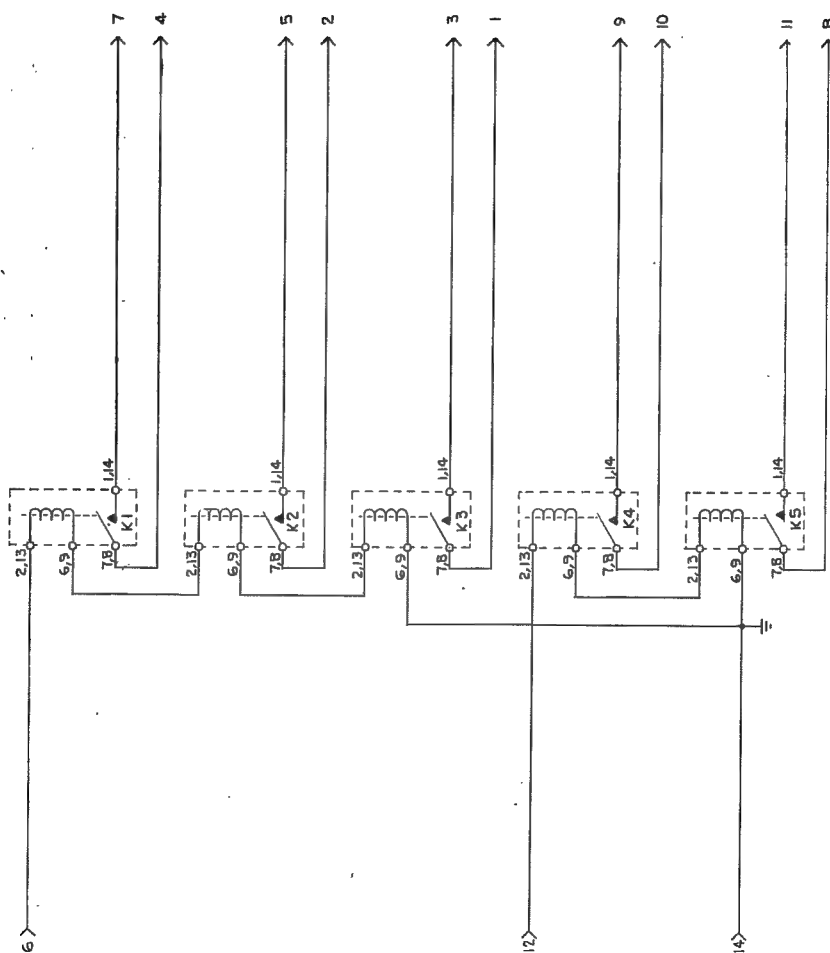
4DLD CARD SWITCHING CIRCUIT

The 4DLD card is a switching circuit consisting of five p-c mounted reed relays. Three relays, S1, S2 and S3, are associated with input pin 6, while relays S4 and S5 are associated with input pin 12. One side of the relay coils which are connected in series is connected to ground via pin 14. The application of +20 volts to the opposite end of the relay coil will energize the coil causing the normally open contacts of the relay to close.



00881906

REV	DATE	DESCRIPTION
1	11-13	RECEIVED CASE 1
2	11-13	REVISED PER EDO
3	11-13	REVISED PER EDO
4	11-13	REVISED PER EDO
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99	11-13	REVISED PER EDO
100	11-13	REVISED PER EDO



NOTES:
1. UNLESS OTHERWISE SPECIFIED ALL RELAYS
TO BE 5180800.

62952600 A

7-49

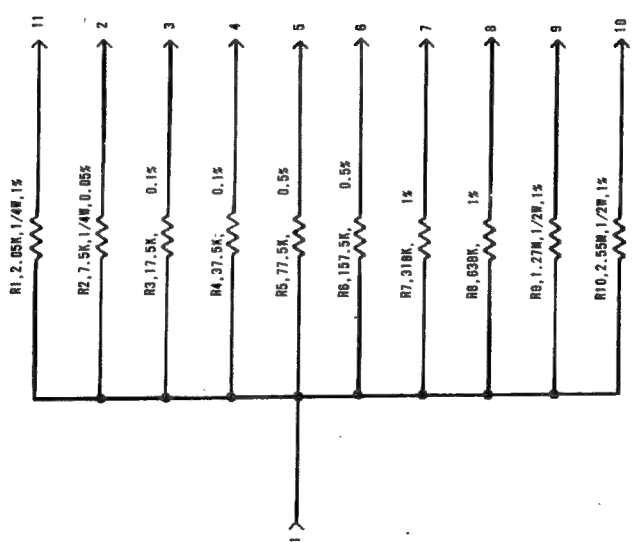
SCHEMATIC DIAGRAM 4DLD (SWITCH CARD)	
15920	90418800
REVISIONS	
REV	DATE
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99	11-13
100	11-13

4DMD CARD D/A RESISTOR NETWORK

This card accepts digital positioning information and converts this information to an analog current. The resulting current is the sum of the individual resistor currents. Considering the source resistance in series with each d/a resistor, the individual resistance combinations are weighted by powers of 2 (with the exception of resistor R1). That is, the resistance for bit 2¹ is half that for 2², etc. Digital information from the lowest order bit feeds the largest resistor, thus creating the smallest analog contribution. Information from higher order bits feeds correspondingly lower resistors, producing larger analog contributions. The resistance of R1 is greater than twice the resistance of R2. This input (R1) is used only in maintenance mode. In the maintenance mode R1 enables the separation between the left and right presentations on the crt screen.

4 3 2 1

SHEET REVISION STATUS				REVISION RECORD			
REV	CO	DESCRIPTION	DATE	CHKD	APP	DATE	CHKD
—	—	RELEASED CLASS 'C'	12-30	T.M.	SG		
01	C196	REVISED PER ECO	3-17-75	DB	SG		
A	9015-11	RELEASED CLASS A	3-27-75	—	SG		



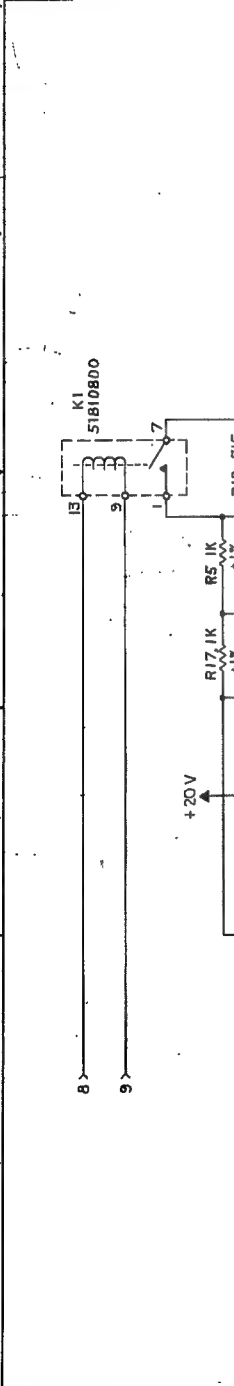
TITLE		SCHEMATIC DIAGRAM 4DND (D/A RESISTOR NETWORK)	
CC545 C+D	CC545 C+D	CODE 15920	DRAWING NO C 90419100
REF USED ON	DRAWN BY	CHKD BY	APP BY
	J.L. SCARFET	J.L. SCARFET	J.L. SCARFET
	12-30-74	12-30-74	12-30-74
	1/24/75	1/24/75	1/24/75
	3/25/75	3/25/75	3/25/75
	3/27/75	3/27/75	3/27/75

4DND CARD CURRENT SUMMING AMPLIFIER

The output voltage at pin 7 reflects the magnitude of the current input to pin 1. Input current ranges from 0 to approximately 2.1 milliamperes (maximum with all bit positions including the Screen Select, bit X2⁹, active). The corresponding changes in output voltage range from 0 volt to -2.6 volts. Feedback network R5/R17/C1 controls the gain of the differential amplifier transistor Q1 and holds the input at pin 1 near ground. Increased input current increases conduction of Q1A and decreases the conduction of Q1B. As a result, Q3 conducts more and pulls the output voltage positive. The reverse is true for a decrease in input current. In the normal mode, the K1 relay is disabled. In maintenance mode, the K1 relay is energized, and the closing of the K1 1-7 contact places R18 in the feedback circuit, reducing the feedback gain.

290419300

REVISION RECORD			
REV	ECO	DESCRIPTION	DATE
1	—	RELEASED CLASS C	10/14/78
2	01	REVISOR PER ECO	11/14/78
3	A	RELEASED CLASS A	11/14/78



62952600 A

7-53

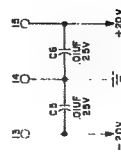
REFERENCE DRAWING			
EC CARD DETAIL CONTROL	EC CARD ASSY 90419300	CC 545	1/1
DATE	11/14/78	DATE	11/14/78
BY	11/14/78	BY	11/14/78
CHKD	11/14/78	CHKD	11/14/78
COMPONENT NAME AS NOTED	NAME	VALUE	UNIT
RESISTOR	10K	10K	Ω
CAPACITOR	100V	100V	V
TRANSISTOR	51003100	51003100	Q
RELAY	51810800	51810800	K
SCHEMATIC DIAGRAM 4DND			
(CURRENT SUMMER AMPLIFIER)			
DATE	15920	DATE	15920
BY	15920	BY	15920
CHKD	15920	CHKD	15920
COMPONENT NAME AS NOTED	NAME	VALUE	UNIT
RESISTOR	10K	10K	Ω
CAPACITOR	100V	100V	V
TRANSISTOR	51003100	51003100	Q
RELAY	51810800	51810800	K

5ADD-0 CARD D/A CONVERTER, POSITIONING

Input Pin	Input Level	Output Pin	Output Level
3 and 9	$\approx +5$ vdc	---	---
1 or 7	-0.5 vdc (logical 0)	5 or 11	0 vdc
1 or 7	-3.0 vdc (logical 1)	5 or 11	+5 vdc

A logical 0 input cuts off the input transistor and turns on the output transistor, yielding a 0-volt output. A +5-volt output results when a logical 1 input turns on the input transistor and turns off the output transistor.

Tolerances of R1 and R8 decrease with higher order bit positions in a d/a conversion network.

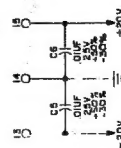
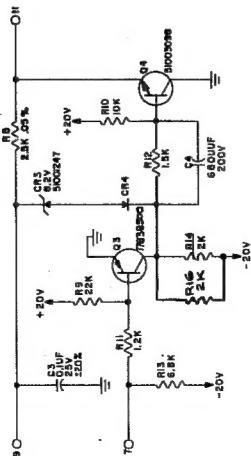
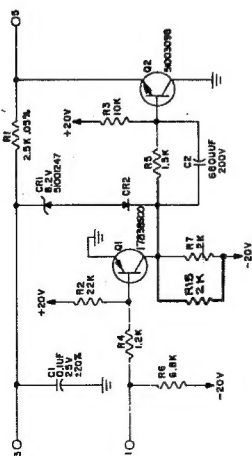
[illegible]

5AED-0 CARD
D/A CONVERTER, POSITIONING

Input Pin	Input Level	Output Pin	Output Level
3 and 9	$\approx +5$ vdc	---	---
1 or 7	-0.5 vdc (logical 0)	5 or 11	0 vdc
1 or 7	-3.0 vdc (logical 1)	5 or 11	+5 vdc

A logical 0 input cuts off the input transistor and turns on the output transistor, yielding a 0-volt output. A +5-volt output results when a logical 1 input turns on the input transistor and turns off the output transistor.

Tolerances of R1 and R8 decrease with higher order bit positions in a d/a conversion network.



REV	ECB	DATE	BY	APPROVAL
A	9-12	9/17/75	RELEAS CLASS A	AC.T.
B	10-17	10-18	REVISED PER ECO	COB

FORM	STATION NAME
B	90422500

[illegible]

5AHD-0 CARD

SYMBOL DEFLECTION AMPLIFIER DRIVER

The 5AHD-0 card amplifies push-pull input signals and applies them to the symbol deflection amplifier. The emitter-followers Q2 and Q3 provide current amplification and low impedance outputs for driving the deflection amplifier. Shorting pins 5-7 and 6-11 reduces the gain of the amplifier by 25%. These pins are shorted in the maintenance mode by the energizing of the 4DLD reed relays.

With the push-pull input, an increase on one pin will be accompanied by a decrease on the other input pin. For example, if pin 4 goes negative and pin 3 positive, Q1A conducts less and Q1B conducts more. Output pins 7 and 11 then go positive and negative respectively. The reverse would be true for opposite polarity swings on input pins 4 and 3. Potentiometer R9 provides symbol size control by controlling the input signal attenuation. Variable capacitor C3 provides symbol smoothness control by regulating amplifier response time.

